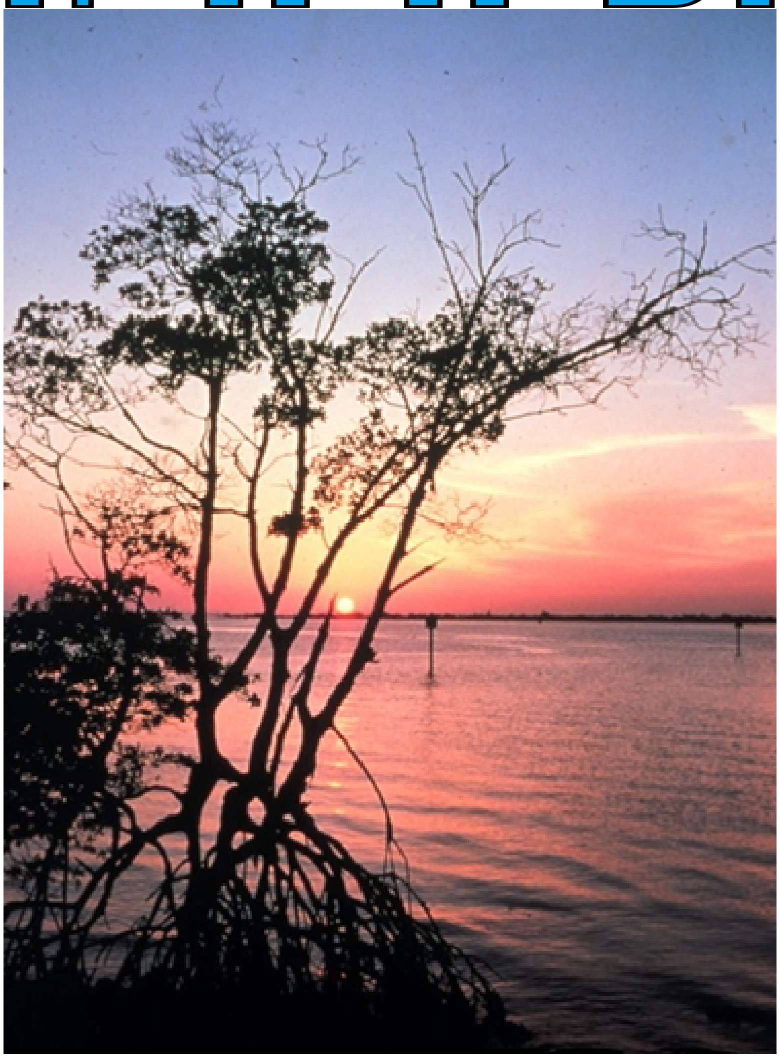
NS&T Program

National Status and Trends Program
for Marine Environmental Quality

TAMPA BAY



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Status and Trends of Contaminant Levels in Biota and Sediments of TAMPA BAY

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INTRODUCTION

As part of its continuing mission to bring important results into the public arena, the NOAA National Status and Trends (NS&T) Program has prepared this summary of its findings in Tampa Bay.

The Tampa Bay is a subtropical estuary located on the Gulf of Mexico coast of Florida. It encompasses more than 1000 km^2 of water and is the largest estuary in the state of Florida (Figure 1). Its 5700-km^2 watershed supports urban, industrial, and agricultural activities. Tampa Bay is a critical habitat for threatened and endangered species including the West Indian manatee and the green turtle. During the twentieth century the Bay suffered significant loss and degradation of primary habitats such as tidal marshes, mangroves, and seagrasses resulting in declines of the scallop, oyster, and finfish fisheries (Lewis and Estevez, 1988).

NATIONAL STATUS AND TRENDS PROGRAM

Our Nation's estuaries and coastal waters receive chemical wastes from industrial, municipal, and agricultural sources. In recent decades, as industrialization has grown and diversified, complex mixtures of synthetic organic compounds, trace elements, and nutrients have been discharged into US coastal waters.

In addition to coming from industrial sources, contaminants are released to the environment in the course of our daily lives. For generations, chemicals from such non-point sources as agricultural runoff, urban runoff, and non-agricultural insect and plant control programs have added significantly to the total burden of coastal contaminants. Airborne transport is another significant source of contaminants to coastal ecosystems. In recent years, coastal contamination has become more of a concern as population growth in these areas has continued to increase steadily. In response, an evolving national effort is underway to determine the extent and impact of contaminants on coastal and estuarine areas and to develop management strategies.

The Center for Coastal Monitoring and Assessment (CCMA), in the National Centers for Coastal Ocean Science (NCCOS) of NOAA's National Ocean Service, conducts a variety of environmental monitoring and assessment studies that are pertinent to NOAA's Environmental Stewardship mission, as outlined in its Strategic Plan: "A Vision for 2005". These studies focus on three long-term goals:

- Assess the status and trends of environmental quality in relation to levels and effects of contaminants and other sources of environmental degradation in US marine, estuarine, and Great Lakes environments;

- Develop diagnostic and predictive capabilities to determine effects of contaminants and other sources of environmental degradation on coastal and

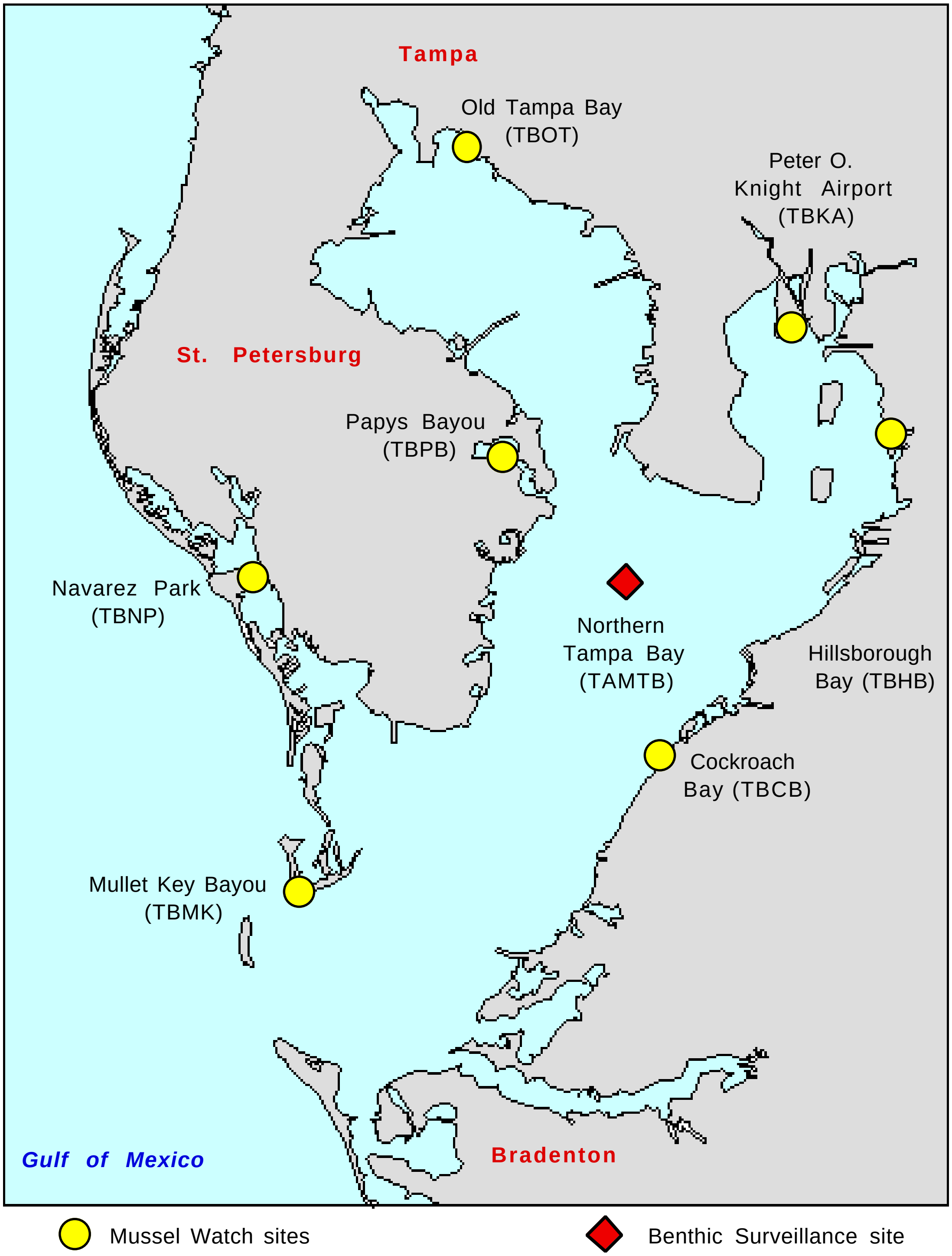


Figure 1. NS&T Mussel Watch and Benthic Surveillance sampling sites in Tampa Bay.

- Develop and disseminate scientifically sound data, information, and services to support effective coastal management and decision making.

NOAA's NS&T Program, managed by CCMA, was initiated in 1984 to determine the status of, and to detect changes in, the environmental quality of the nation's coastal waters. This program monitors contaminant levels through the **Mussel Watch Project,** which determines concentrations of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCB) congeners, several pesticides, butyltins, and selected trace elements in sediment and mollusk samples from U.S. coastal waters (Table 1). Data are used to determine the extent and temporal trends of chemical contamination on a nationwide basis and to identify which coastal areas are at greater risk in terms of threats to environmental quality. The Mussel Watch network consists of more than 280 sites. The **Quality Assurance Project** is designed to document sampling protocols, analytical procedures, and laboratory performances of the Mussel Watch Project and is an integral part of the NS&T Program.

SURVEY METHODS

Mussel Watch Project sites are sampled at regular intervals (biennially in winter for mollusks, less frequently for sediments). The sites are designed to describe national and regional distributions of contamination. Mussel Watch sites are selected to represent large coastal areas and to avoid small-scale patches of contamination, or "hot spots." Sites selected for monitoring are generally 10 to 100 km apart. Where possible, sites were selected to coincide with historical monitoring sites such as the Environmental Protection Agency's Mussel Watch sites sampled during the 1970s, and to complement sites sampled through state programs such as the California Mussel Watch Program (Lauenstein, 1996).

Mollusks (mussels or oysters) and sediments are collected at each Mussel Watch Project site. Several species of mollusks are collected: blue mussels (*Mytilus edulis*) from the US North Atlantic; blue mussels (*Mytilus* species) and California mussels (*M. californianus*) from the Pacific coast; eastern oysters (*Crassostrea virginica*) from the South Atlantic and the Gulf of Mexico; smooth-edge jewelbox (*Chama sinuosa*) from the Florida Keys; Caribbean oyster (*C. rhizophorae*) from Puerto Rico; Hawaiian oysters (*Ostrea sandvicensis*) from Hawaii; and zebra mussels (*Dreissena polymorpha* and *D. bugensis*) from the Great Lakes. Coastal and estuarine mollusks are collected by hand or dredged from intertidal to shallow subtidal zones, brushed clean, packed in dry ice, and shipped to the analytical laboratory. Sediments are collected using a grab sampler and the top two centimeters are removed for analysis. The mollusk and sediment samples are usually shipped to the laboratory within a day of collection.

In the laboratory, molluscan samples are composited to include about 20 or 30 individuals for oysters and mussels, respectively. The molluscan composite samples and sediment samples are analyzed for organic and metal contaminants. The sampling and analytical protocols are described in detail in Lauenstein and Cantillo (1993, 1998). Data are also available from the NS&T **Benthic Surveillance Project** that analyzed contaminant levels and effects in sediment and fish from over 100 sites in 1984 through 1992. This Project's sediment data are combined with those of the Mussel Watch Project data in this report.

The NS&T Mussel Watch and Benthic Surveillance sites in Tampa Bay are shown in Figure 1. The site names, acronyms, latitudes and longitudes, years of data availability, and human populations within 20 km of the sites are listed in Table 2.

The average concentrations of major and trace elements and of categories of organic compounds in sediment are shown graphically in Appendix I. Appendix II provides graphical representations of trace element and organic concentrations in oysters through time at the sampling sites in Tampa Bay.

TABLE 1

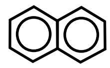
Organic contaminants and major and trace elements determined as part of the NS&T Program.

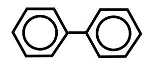
(Number below chemical structure is the Chemical Abstracts Service registry number.)

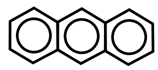
Polycyclic aromatic hydrocarbons

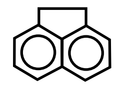
Low molecular weight PAHs
(2- and 3-ring structures)

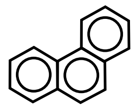
1-Methylnaphthalene
1-Methylphenanthrene
2-Methylnaphthalene
2,6-Dimethylnaphthalene
1,6,7-Trimethylnaphthalene
Acenaphthene
Acenaphthylene
Anthracene
Biphenyl
Fluorene
Naphthalene
Phenanthrene

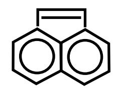

Naphthalene
91-20-3

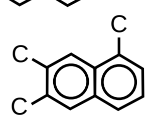

Biphenyl
92-52-4


Anthracene
120-12-7

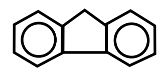

Acenaphthene
83-32-9

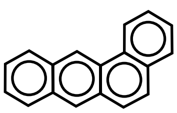

Phenanthrene
85-01-8

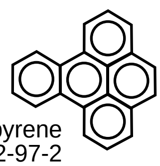

Acenaphthylene
208-96-8

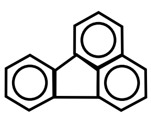


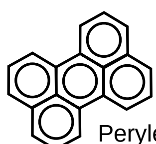
1,6,7-Trimethylnaphthalene
2245-38-7

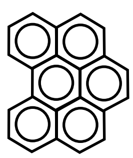

Fluorene
86-73-7

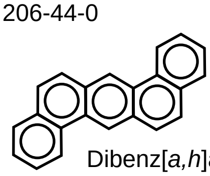

Benz[*a*]anthracene
56-55-3


Benzo[*e*]pyrene
192-97-2


Fluoranthene
206-44-0


Perylene
198-55-0


Benzo[*ghi*]perylene
191-24-2

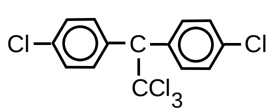

Dibenz[*a,h*]anthracene
53-70-3

High molecular weight PAHs
(4-, 5-, and 6-rings)

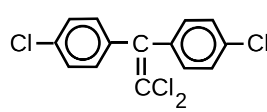
Benz[*a*]anthracene
Benzo[*a*]pyrene
Benzo[*b*]fluoranthene
Benzo[*e*]pyrene
Benzo[*ghi*]perylene
Benzo[*k*]fluoranthene
Chrysene
Dibenz[*a,h*]anthracene
Fluoranthene
Indeno[1,2,3-*cd*]pyrene
Perylene
Pyrene

Chlorinated pesticides

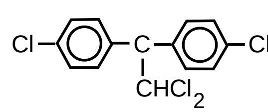
2,4'-DDD
4,4'-DDD
2,4'-DDE
4,4'-DDE
2,4'-DDT
4,4'-DDT



4,4'-DDT
50-29-3



4,4'-DDE
72-55-9



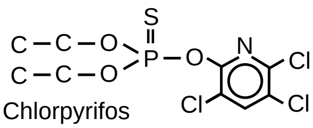
4,4'-DDD
72-54-8

TABLE 1 (cont.)

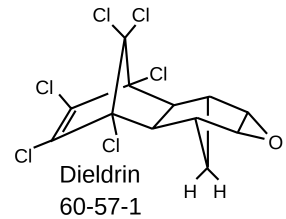
Organic contaminants, and major and trace elements determined as part of the NS&T Program.

(Number below chemical structure is the Chemical Abstracts Service registry number.)

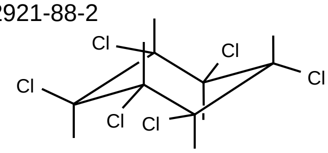
Aldrin
Chlorpyrifos
cis-Chlordane
Dieldrin
Endosulfan-II
delta-Hexachlorocyclohexane
gamma-Hexachlorocyclohexane (Lindane)
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
alpha-Hexachlorocyclohexane
beta-Hexachlorocyclohexane
Mirex
cis-Nonachlor
trans-Nonachlor
Oxychlordane



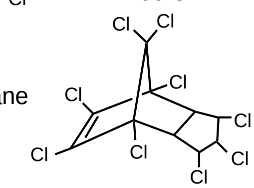
Chlorpyrifos
2921-88-2



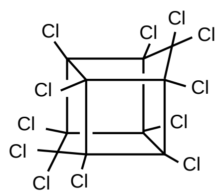
Dieldrin
60-57-1



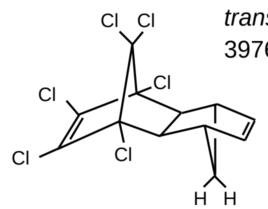
gamma-Hexachlorocyclohexane
58-89-9



trans-Nonachlor
39765-80-5



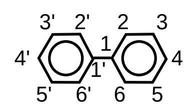
Mirex
2385-85-5



Aldrin
309-00-2

Polychlorinated biphenyl congeners (IUPAC numbering system)

PCB 8, PCB 18, PCB 28, PCB 44, PCB 52, PCB 66, PCB 101, PCB 105, PCB 118, PCB 128, PCB 138, PCB 153, PCB 170, PCB 180, PCB 187, PCB 195, PCB 206, PCB 209

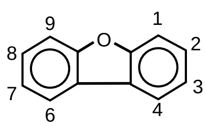


PCB parent structure

Planar PCBs (PCB 77, PCB 126, PCB 169)

Chlorinated dibenzofurans

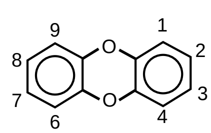
2,3,7,8-Tetrachlorodibenzofuran
1,2,3,7,8-Pentachlorodibenzofuran
2,3,4,7,8-Pentachlorodibenzofuran
1,2,3,4,7,8-Hexachlorodibenzofuran
1,2,3,6,7,8-Hexachlorodibenzofuran
2,3,4,6,7,8-Hexachlorodibenzofuran
1,2,3,7,8,9-Hexachlorodibenzofuran
1,2,3,4,6,7,8-Heptachlorodibenzofuran
1,2,3,4,7,8,9-Heptachlorodibenzofuran
Octachlorodibenzofuran



Dibenzofuran parent structure

Chlorinated dibenzodioxins

2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin
1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin
Octachlorodibenzo-*p*-dioxin



Dibenzo-*p*-dioxin parent structure

TABLE 1 (cont.)

Organic contaminants, and major and trace elements determined as part of the NS&T Program.

(Number below chemical structure is the Chemical Abstracts Service registry number.)

Major and trace elements

Al	-	aluminum	Cu	-	copper	Ag	-	silver
Si	-	silicon	Zn	-	zinc	Cd	-	cadmium
Cr	-	chromium	As	-	arsenic	Hg	-	mercury
Mn	-	manganese	Se	-	selenium	Tl	-	thallium
Fe	-	iron	Sn	-	tin	Pb	-	lead
Ni	-	nickel	Sb	-	antimony			

Organotins

Monobutyltin^{3+}, dibutyltin^{2+}, tributyltin^{+}, tetrabutyltin

TABLE 2

NS&T sampling sites in Tampa Bay and nearby coastal areas.

Site	Site code	Latitude (N)	Longitude (W)	Years of tissue data*	Population$^{\Delta}$ (20 km of site)
Mussel Watch Project					
Eastern oyster, *Crassostrea virginica*					
Mullet Key Bayou	TBMK	27° 37.28' N	82° 43.59' W	10	257
Navarez Park	TBNP	27° 47.28' N	82° 45.23' W	7	267829
Papys Bayou	TBPB	27° 50.53' N	82° 36.69' W	10	161469
Old Tampa Bay	TBOT	28° 01.48' N	82° 37.97' W	7	123224
Peter O. Knight Airport	TBKA	27° 54.46' N	82° 27.23' W	7	196353
Hillsborough Bay	TBHB	27° 51.28' N	82° 23.68' W	6	44178
Cockroach Bay	TBCB	27° 40.55' N	82° 31.06' W	9	10586
Benthic Surveillance Project					
Pinfish, *Lagodon rhomboides*					
Northern Tampa Bay	TAMTB	27° 46.8' N	82° 34.3' W	3	Not available

$^{\Delta}$ 1990 Census.

RESULTS AND DISCUSSION

Status

Oysters

Crassostrea virginica specimens were collected at seven Mussel Watch sites in Tampa Bay. The NS&T sites were: Mullet Key Bayou (TBMK), Navarez Park (TBNP), Papys Bayou (TBPB), Old Tampa Bay (TBOT), Peter O. Knight Airport (TBKA), Hillsborough Bay (TBHB), and Cockroach Bay (TBCB).

The Navarez Park site (TBNP) is located on the east side of Boca Ciega Bay and is surrounded by the city of St. Petersburg (Lauenstein *et al.*, 1997). This site is next to an old boat basin and sand ramp that is no longer used. Several sources for contamination are possible at this site, such as urban runoff and pollution from marine boat traffic.

The site in Papys Bayou (TBPB) is also within St. Petersburg, near the Weeden Island Wildlife Refuge (Lauenstein *et al.*, 1997). Potential sources of contamination at this site include heavy recreational boating in a restricted embayment and an electric power generation plant nearby.

Old Tampa Bay (TBOT) is in the area of the original city of Tampa (Lauenstein *et al.*, 1997). Contamination at the site was not obvious, but mobile home and housing developments were present upstream from the collection site. No industrial contaminant sources were observed.

The Peter O. Knight Airport (TBKO) site is located on the south end of the Davis Islands, adjacent to the Peter O. Knight Airport and the Davis Islands Yacht Club (Lauenstein *et al.*, 1997). The Hillsborough River reaches Hillsborough Bay near this site. No sources of contaminants were identified, apart from run-off from the runway.

The site in Hillsborough Bay (TBHB) is located on the north bank of the Alafia River in the city of Bradon (Lauenstein *et al.*, 1997). One obvious source of contamination is a phosphate plant directly adjacent to the oyster collection site. Hillsborough Bay is surrounded by a large metropolitan complex, supports extensive industrial activity, and serves as a major shipping port of fertilizer products (Johansson *et al.*, 1992).

The Cockroach Bay (TBCB) site is on an exposed reef on a very small island (mostly subtidal) near the southeast shore (Lauenstein *et al.*, 1997). There were no obvious point sources of contamination around this very secluded site, although the surrounding area appeared to support vegetable and fruit farms.

The site furthest from human habitation is located in the southwest corner of Mullet Key Bayou (TBMK), near the Fort DeSoto County Park (Lauenstein *et al.*, 1997). There are no obvious point sources of contamination in the area.

Oysters and mussels are not equal in their ability to concentrate trace elements (O'Connor, 1993). The trace elements Ag, Cu, and Zn are ten times or more concentrated in the oyster *C. virginica* than in the mussel *M. edulis.* Conversely, Pb is more than three times higher in the mussel than in the oyster. Therefore, only the national level NS&T oyster data were used to compare to the Ag, Cu, Pb, and Zn Tampa Bay oyster data. The differences in bioaccumulation between oysters and mussels for Ni, As, Se, Cd, Hg, and the organic analytes are not sufficiently great as to prevent the combination of data from the two bivalves.

Tampa Bay data were compared to the nationwide NS&T median and 85th percentile values for oysters. Concentrations above the 85th percentiles are the highest 15% of the data set and are used as a measure of "high" concentrations. Percentiles are robust with regard to both outliers and concentrations below the detection limit. The NS&T medians and 85th percentiles are listed in Table 3.

Overall, most of the concentrations of chemicals in oysters collected in Tampa Bay were below the NS&T 85th percentile values. Some exceptions were found at sampling sites near urban areas with significant human populations (Figure 2). High values of As were found at Mullet Key and Navarez Park; of Hg at Cockroach Bay, Papys Bayou, Old Tampa Bay

TABLE 3

NS&T Mussel Watch Data medians and 85th percentile values (1986 - 1997)
(Medians and percentiles were determined using the average at each site across all sampled years. Element data in µg/g dry wt. unless noted, and organic data in ng/g dry wt.).

Oyster data only

	Cu	Zn	Ag	Pb
n	128	128	128	128
Median	140	2200	2.3	0.51
85th percentile	290	4600	5.0	0.82

Mussel and oyster data

	Ni	As	Se	Cd	Hg
n	281	281	281	281	280
Median	1.9	9.2	2.8	2.8	0.10
85th percentile	2.1	16	3.9	5.9	0.21

	ΣDDTs	ΣPCBs	ΣPAHs	ΣCdane	ΣDieldrin
n	280	280	268	280	280
Median	33	100	300	10	5.1
85th percentile	140	450	1200	32	15

	Mirex	Hexachloro-benzene	Lindane	Endrin	ΣBTs
n	280	280	280	45	250
Median	0.24	0.23	1.2	0.38	54
85th percentile	1.2	1.1	2.8	2.3	200

Sediment data (Calculated using Mussel Watch Project sediment data only.)

	Al (%)	Si (%)	Cr	Mn	Fe (%)
n	223	178	222	199	223
Median	2.4	3.0	54	370	2.1
85th percentile	4.8	36	120	740	3.7

	Ni	Cu	Zn	As	Se
n	223	223	223	223	207
Median	17	14	67	6.9	0.38
85th percentile	36	47	130	12	0.74

	Ag	Cd	Sn	Sb	Hg
n	223	223	223	178	223
Median	0.11	0.19	1.3	0.47	0.057
85th percentile	0.59	0.56	3.1	1.8	0.22

TABLE 3 (cont.)

NS&T Mussel Watch Data medians and 85th percentile values (1986 - 1997)
(Medians and percentiles were determined using the average at each site across all sampled years. Element data in µg/g dry wt. unless noted, and organic data in ng/g dry wt.).

	Tl	Pb	TOC (%)	∑DDTs	∑PCBs
n	145	223	220	224	224
Median	0.073	18	1.0	2.9	15
85th percentile	0.56	40	2.4	18	80

	∑PAHs	∑Cdane	∑Dieldrin	Mirex
n	224	224	224	224
Median	380	0.51	0.30	0.002
85th percentile	2300	3.1	1.9	0.36

	Hexachloro-benzene	Lindane
n	223	224
Median	0.14	0.04
85th percentile	0.92	0.47

∑DDTs: The sum of concentrations of DDTs and its metabolites, DDEs and DDDs.
∑PCBs: The sum of the concentrations of homologs, which is approximately twice the sum of the 18 congeners.
∑PAHs: The sum of concentrations of the 18 PAH compounds.
∑Cdane: The sum of *cis*-chlordane, *trans*-nonachlor, heptachlor and heptachlorepoxide.
∑Dieldrin: The sum of dieldrin and aldrin.
∑BTs: The sum of the concentrations of tributyltin and its breakdown products dibutyltin and monobutyltin (as ng Sn/g dry wt.).
n: Number of data points (roughly equivalent to the number of sampling sites).

Mussel Watch sampling site in Papys Bayou (TAMU/GERG)

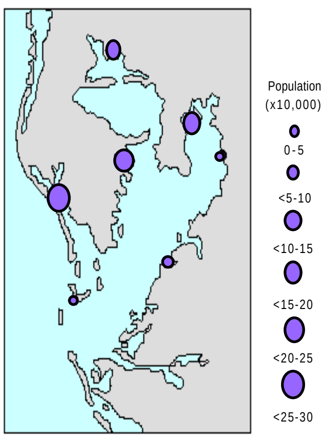


Figure 2. Population within 20 km of the NS&T sampling sites.

and Navarez Park; of Pb at all sites except Mullet Key and Cockroach Bay; of Zn at Old Tampa Bay and Peter O. Knight Airport; of total chlordane pesticides at all sites except Mullet Key and Old Tampa Bay; of mirex at all sites except Old Tampa Bay; and of total tributyltins at Hillsborough Bay and Peter O. Knight Airport.

Sediment

The levels of the major and trace elements measured in sediment as part of the NS&T Program at the Tampa Bay sites were below the NS&T 85th percentile except for Se at Navarez Park, Papys Bayou, and Hillsborough Bay; Cd at Navarez Park and Hillsborough Bay; and Pb at Hillsborough Bay. The levels of ∑PAHs, ∑PCBs, and ∑DDTs and metabolites were below the 85th percentile. Levels higher than the 85th percentile of some chlorinated pesticides and chlorinated pesticide aggregates were found in the Bay. High levels of total chlordane pesticides were found at Navarez Park, Papys Bayou, and Peter O. Knight Airport; of dieldrin and aldrin at Navarez Park and Peter O. Knight Airport; of hexachlorobenzene at Mullet Key; and of mirex at Mullet Key, Navarez Park, Hillsborough Bay, and Cockroach Bay. The levels of mirex at some of the low population sites could be the result of agricultural activities.

Trends

Contamination trends at the NS&T sites around the US from 1986 through 1995 have been identified by statistically comparing yearly average concentrations in mollusk samples from each of 186 sites that were sampled for at least six years. Calculations for each chemical at each sampling site showed increasing, decreasing, or no trend over time. The most common observation was no trend, but in the cases where trends were found, many more were decreasing than increasing. Contamination nationwide is decreasing for chemicals whose use has been banned, such as chlordane, ∑DDTs, and dieldrin, or severely curtailed, such as tributyltins and Cd. For other chemicals there is no evidence, on a national scale, for either increasing or decreasing trends (O'Connor, 1996). Table 4 shows the numbers of sites in South Florida and nationwide with Increasing (I), Decreasing (D), or No Trends (NT) in concentrations of each chemical.

The numbers in Table 4 are the result of a statistical test that will identify random sequences as real trends about 5% of the time. Since 186 sites were examined for each chemical, this means about 10 of the trends per chemical could be due to random variations. That is why we have not given much weight to the relatively few trends that appear for most of the trace elements and for PAHs.

Statistical correlations were also developed for the median (50th percentile) value of chemical concentrations among all sites sampled in each year from 1986 to 1995 versus year. These plots of annual medians show, at this national level of aggregation, decreasing trends for Cd, Cu in mussels, Zn in mussels, all the chlorinated organics, ∑PAHs, and ∑BTs. However the Cu, Zn, and ∑PAHs decreases were not evident in the site-by-site results.

Decreasing trends are anticipated for the monitored chlorinated hydrocarbons and tributyltins because all these chemicals have been banned for use in the United States and tributyltin has been banned as a biocide on small boats. Annual use of Cd in the U.S. decreased over the period of 1986 through 1996.

Decreasing trends in Tampa Bay were found for: Hg and total chlordane pesticides at Cockroach Bay; Cd, mirex, and total tributyltins at Peter O. Knight Airport; Hg at Old Tampa Bay; As, DDT and metabolites, total chlordane pesticides, and hexachlorobenzene at Mullet Key; hexachlorobenzene and total tributyltins at Navarez Park; and Ni, Hg, DDT and metabolites, total chlordane pesticides, and mirex at Papys Bayou. Increasing trends of Sn were found at Cockroach Bay, of lindane at Hillsborough Bay, and of total PAHs at Papys Bayou (Table 4).

CONCLUSIONS

In general, most of the concentrations of chemicals measured by the NS&T Program in oyster tissue in Tampa Bay were below the nationwide NS&T 85th percentile value. Exceptions were found at sampling sites with significant human populations or at sites influenced by agricultural activites. High levels of As were found in the oysters collected at Navarez Park and Mullet Key, of Hg at Old Tampa Bay, Cockrooach Bay, and Mullet Key, of Pb at Peter O. Knight Airport, Papys Bayou and Hillsborough Bay, of ∑PAHs in Hillsborough Bay, of ∑PCBs and ∑DDTs at Peter O. Knight Airport, of chlordane pesticides at Peter O. Knight Airport, Cockroach Bay, Papys Bayou, and Navarez Park, of ∑BTs at Peter O. Knight Airport, and of mirex at all sites.

The levels of elements and organic compounds found in sediment were mostly below the NS&T 85th percentiles. High values at some sites were found for Se, Cd, Pb, total chlordane pesticides, dieldrin and aldrin, hexachlorobenzene, and mirex.

ACKNOWLEDGMENTS

The authors with to thank the numerous chemists at the NOAA National Marine Fisheries Service and Texas A&M University (TAMU/GERG), and A. E. Theberge (NOAA Central Library) for graphics assistance.


Mussel Watch sampling site in Cockroach Bay (TAMU/GERG)

TABLE 4

National trends in chemical concentrations measured as part of the NS&T Mussel Watch Project and trends for the seven Tampa Bay area sites (TBCB, TBHC, TBKA, TBOT, TBMK, TBNP, TBPB) for which data exist for the years 1986-1997.

	Trend				Trend		
Aggregated chemicals*	I	D	NT	Element	I	D	NT
ΣCdane	1	81 (3)	104	As	11	11 (1)	164
ΣDDT	1	38 (2)	147	Cd	3	28 (1)	155
ΣDield	1	32	153	Cu	7	14	165
ΣPCB	1	37	148	Hg	7	9 (3)	170
ΣPAH	3 (1)	3	180	Ni	6	8 (1)	172
ΣBT	0	18 (2)	168	Pb	14	9	163
				Se	8	9	169
				Zn	7	9	170

I - Increasing, D - Decreasing, NT - No trend. Increasing and decreasing trends for Tampa Bay are given in parenthesis.
* Individual organic compound concentrations have usually been aggregated into these groups:
ΣDDTs: The sum of concentrations of DDTs and its metabolites, DDEs and DDDs.
ΣCdane: The sum of *cis*-chlordane, *trans*-nonachlor, heptachlor, and heptachlorepoxide.
ΣPCBs: The sum of the concentrations of di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, and nonachlorobiphenyls.
ΣPAHs: The sum of concentrations of the 18 PAH compounds.
ΣBTs: The sum of the concentrations of tributyltin and its breakdown products dibutyltin and monobutyltin (as tBT/g dry wt.).

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NS&T DATA AND INFORMATION PRODUCTS

Data and information resulting from CCMA activities are made available to users and the scientific community at large in different formats and media.

NOAA Technical Memoranda provide detailed accounts of methods, data summaries, and results of various NS&T Program projects and related activities, such as sediment toxicity surveys, analytical methods, and sediment quality assessments.

Digitized data and program information about the NS&T program are available via electronic mail. Presently, data from the Mussel Watch Project (1984-1994) and the Benthic Surveillance Project (1984-1992) can be retrieved by downloading from the NCCOS Information Service which can be accessed at (http://ccmaserver.nos.noaa.gov). New data sets are added to the Service as they are digitized and checked for accuracy. The data sets can also be requested from CCMA.

Scientific publications containing the results of CCMA projects are published as research papers in journals, books, and proceedings of professional conferences. The publications are authored by CCMA staff, contractors, and collaborators. A cumulative list of these publications is issued periodically.

Mussel Watch sampling site in Cockroach Bay (TAMU/GERG)

For further information on the NS&T Program or to obtain a list of available publications, write:

Oyster shells (TAMU/GERG)

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NOAA/NOS/NCCOS/CCMA
1305 East/West Highway
Silver Spring, MD 20910

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Appendix I

Sediment data

(Concentrations noted with a diamond are above the NS&T nationwide 85th percentile.)

Chromium in sediment

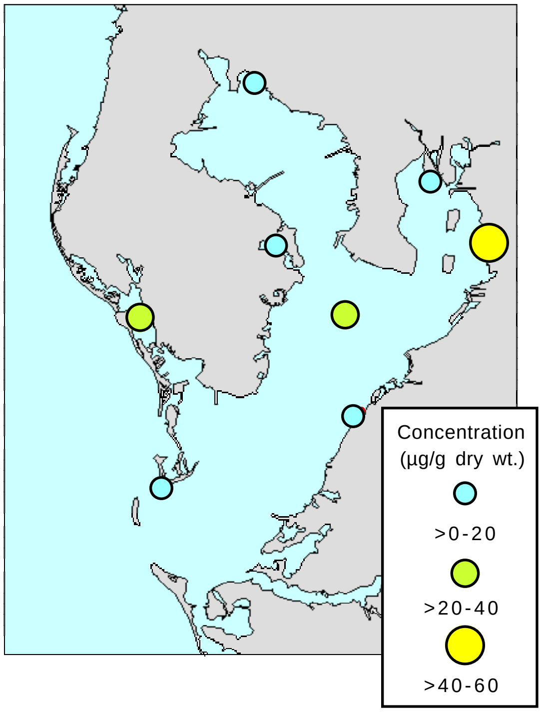

Figure I.1. Chromium in sediment (µg/g dry wt.).

Manganese in sediment

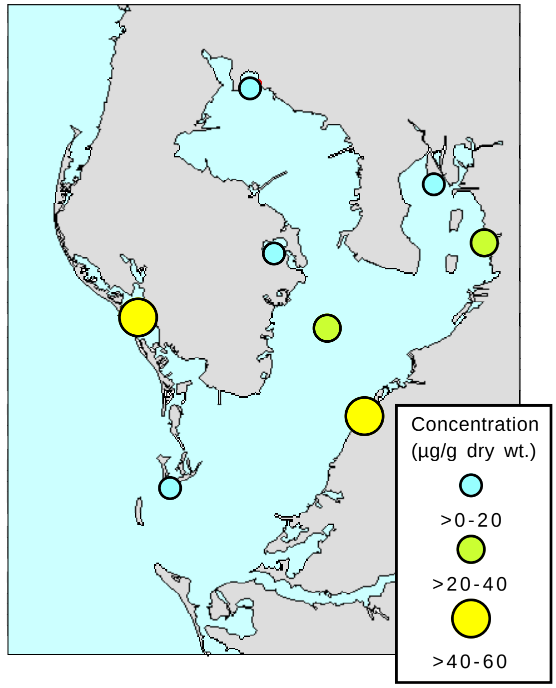

Figure I.2. Manganese in sediment (µg/g dry wt.).

Mussel Watch sampling site at Mullet Key (TAMU/GERG)

Nickel in sediment

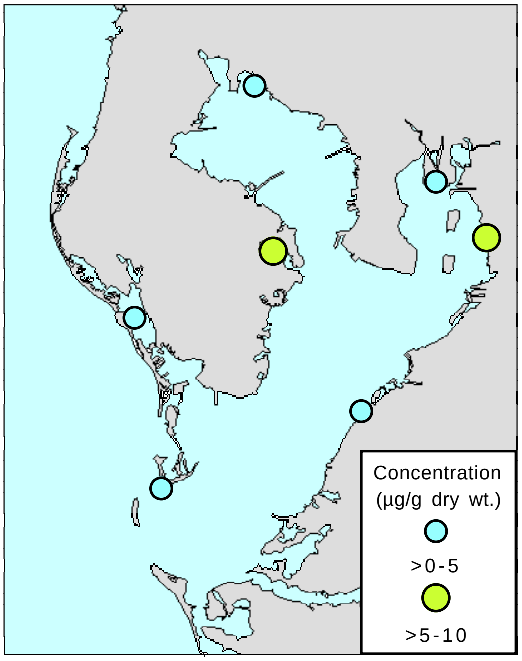

Figure I.3. Nickel in sediment (µg/g dry wt.).

Copper in sediment

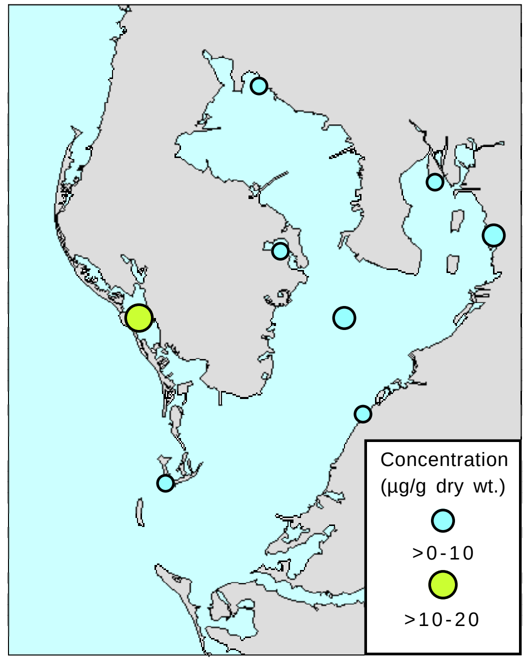

Figure I.4. Copper in sediment (µg/g dry wt.)

Zinc in sediment

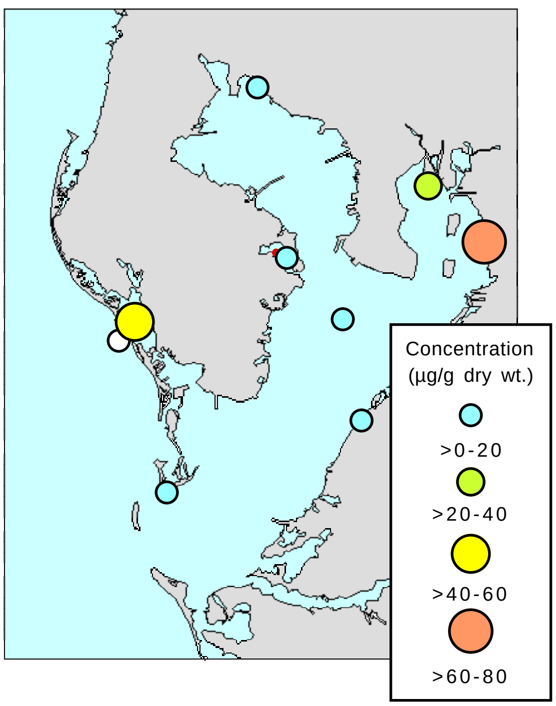

Figure I.5. Zinc in sediment (µg/g dry wt.).

Arsenic in sediment

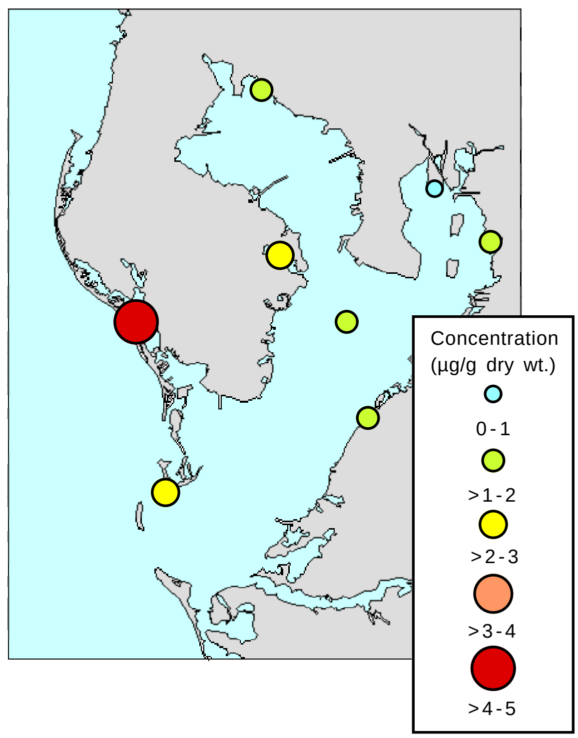

Figure I.6. Arsenic in sediment (µg/g dry wt.).

Selenium in sediment

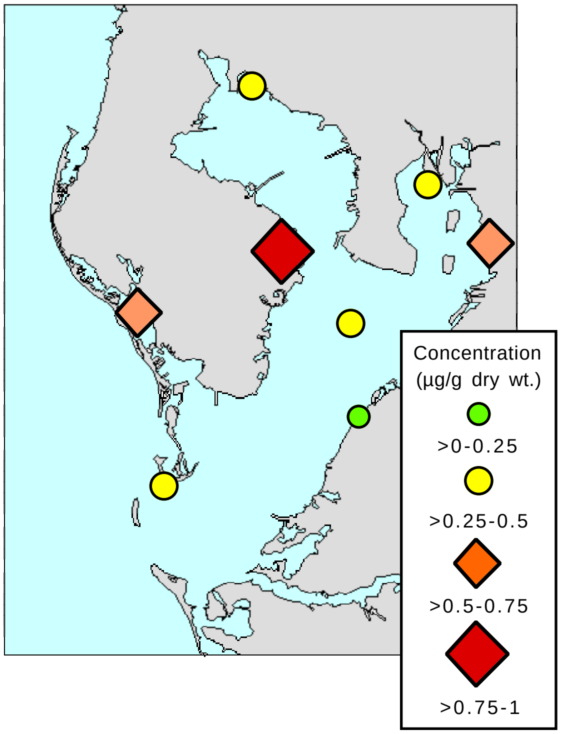

Figure I.7. Selenium in sediment. (µg/g dry wt.).

Silver in sediment

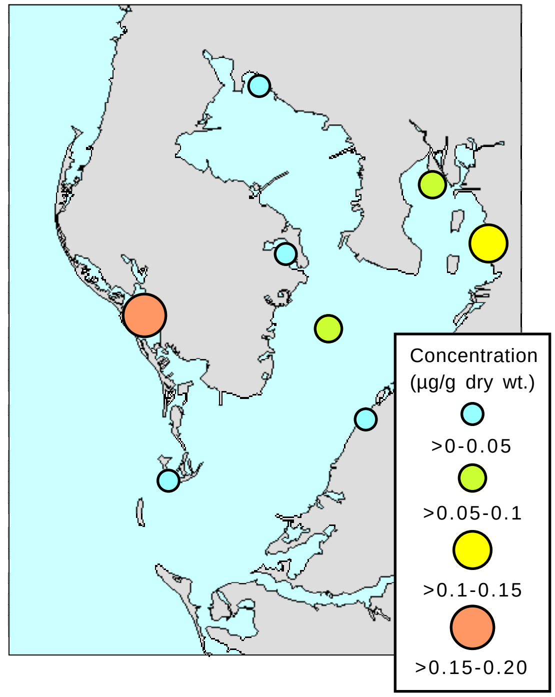

Figure I.8. Silver in sediment (µg/g dry wt.).

Cadmium in sediment

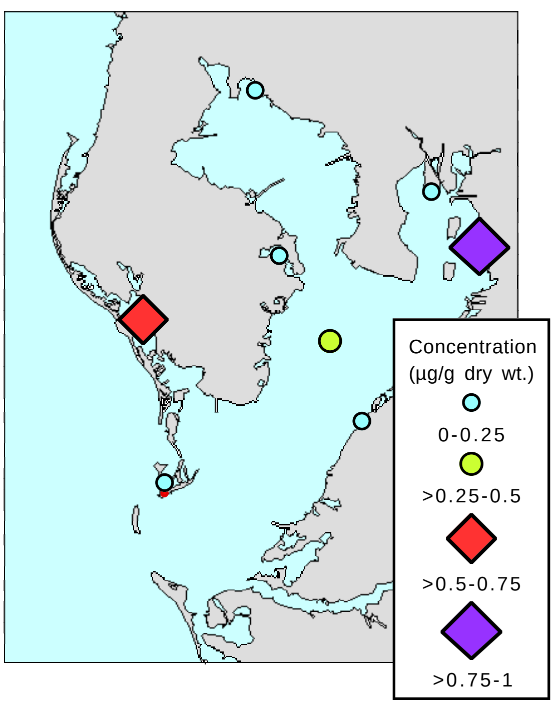

Figure I.9. Cadmium in sediment (µg/g dry wt.).

Tin in sediment

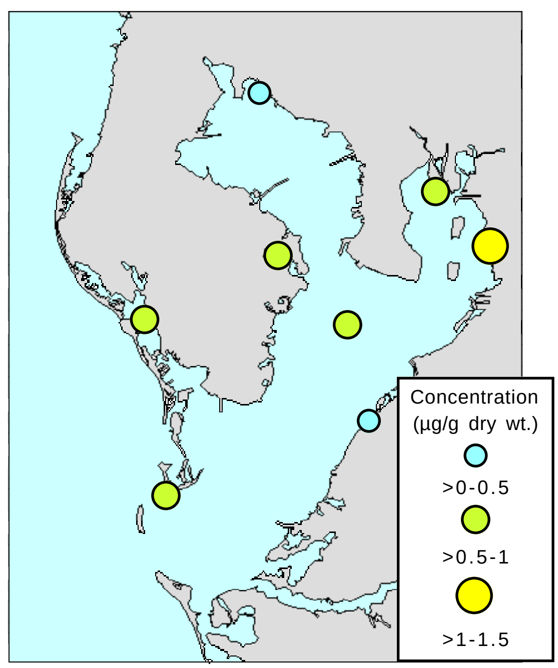

Figure I.10. Tin in sediment (µg/g dry wt.).

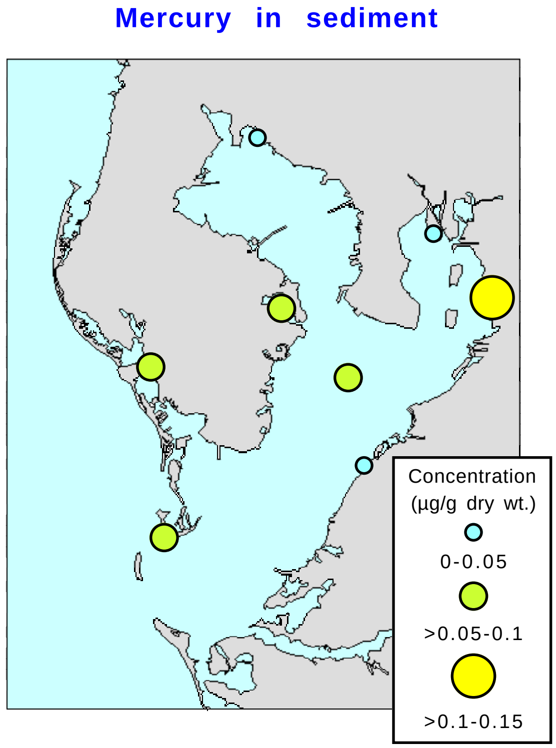

Figure I.11. Mercury in sediment (µg/g dry wt.).

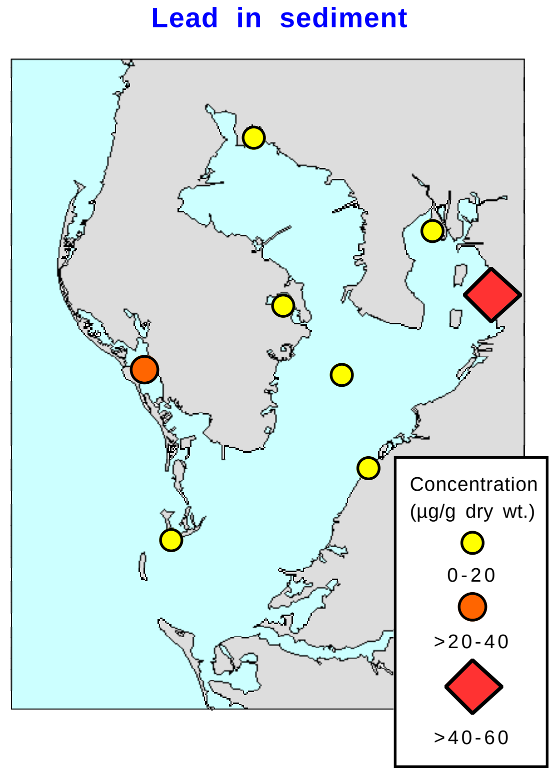

Figure I.12. Lead in sediment. (µg/g dry wt.).

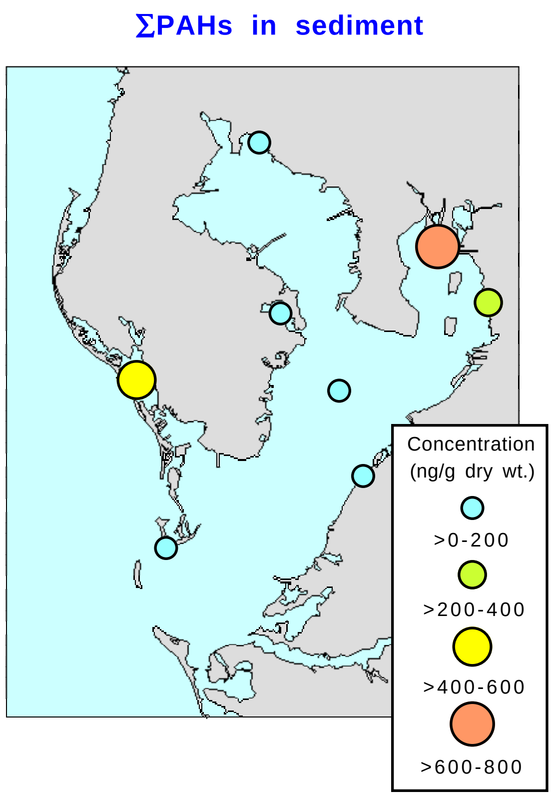

Figure I.13. ∑PAHs in sediment (ng/g dry wt.).

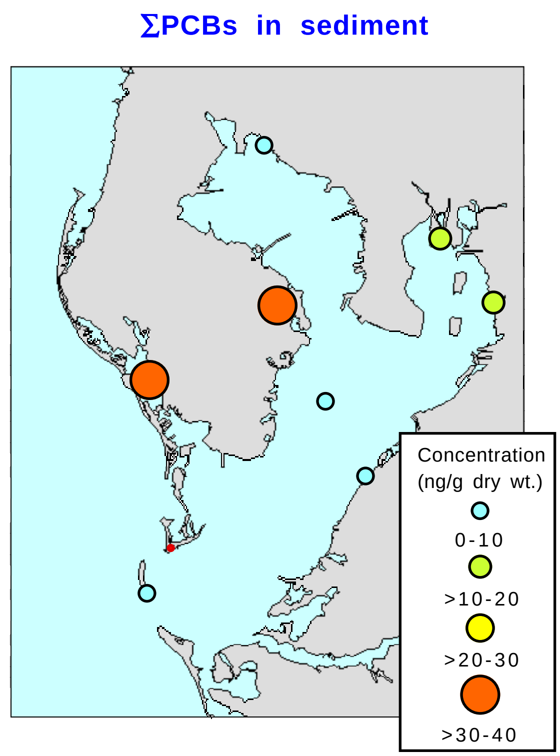

Figure I.14. ∑PCBs in sediment (ng/g dry wt.).

∑DDTs and metabolites in sediment

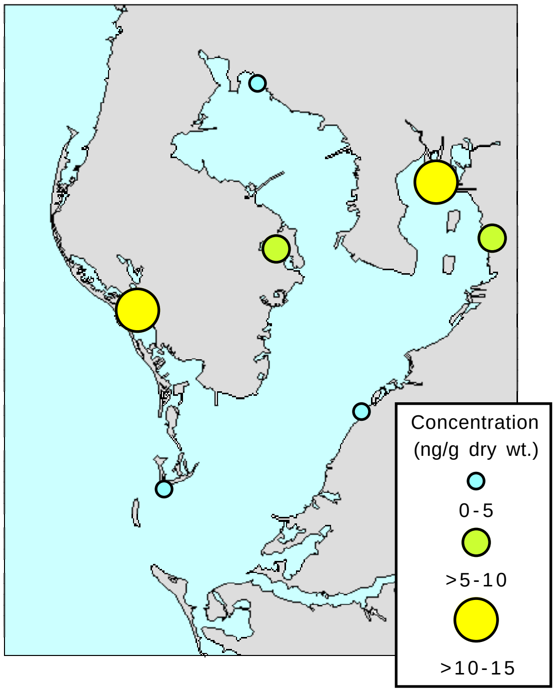

Figure I.15. ∑DDTs and metabolites in sediment (ng/g dry wt.).

Total chlordane pesticides in sediment

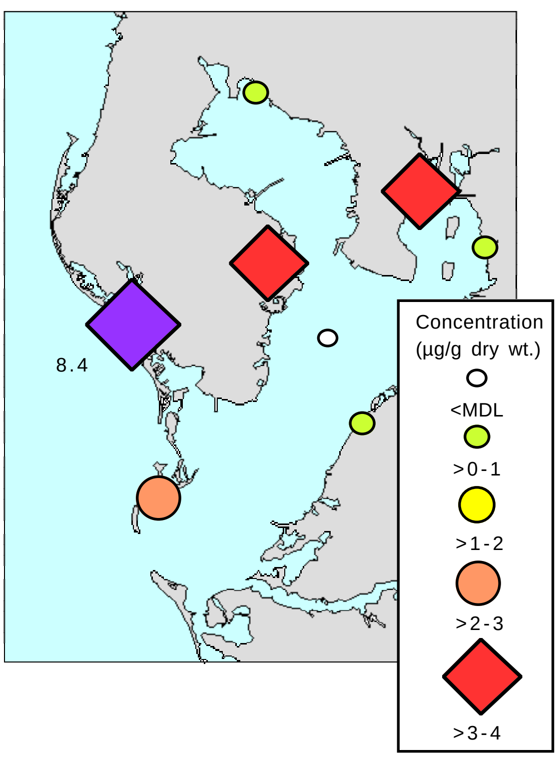

Figure I.16. Total chlordane pesticides in sediment. A white circle denotes a value below the method limit of detection (MDL) (ng/g dry wt.).

Dieldrin + aldrin in sediment

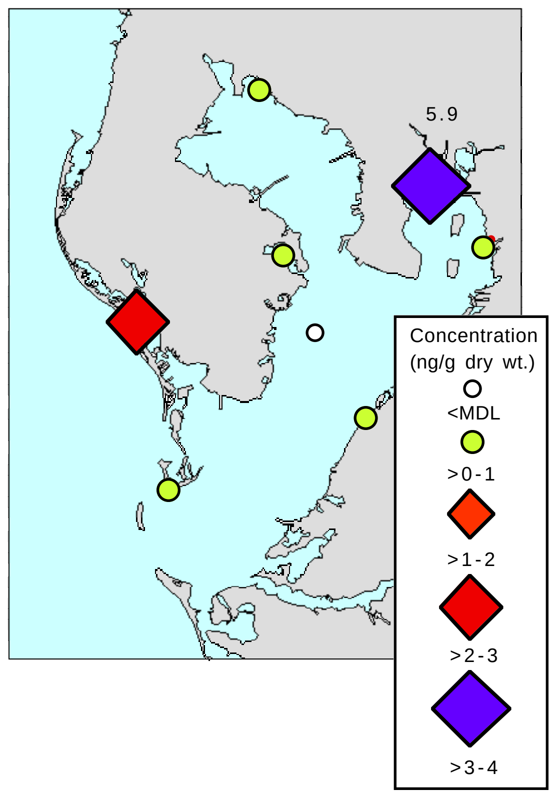

Figure I.17. Dieldrin + aldrin in sediment.. A white circle denotes a value below the method limit of detection (MDL) (ng/g dry wt.).

Hexachlorobenzene in sediment

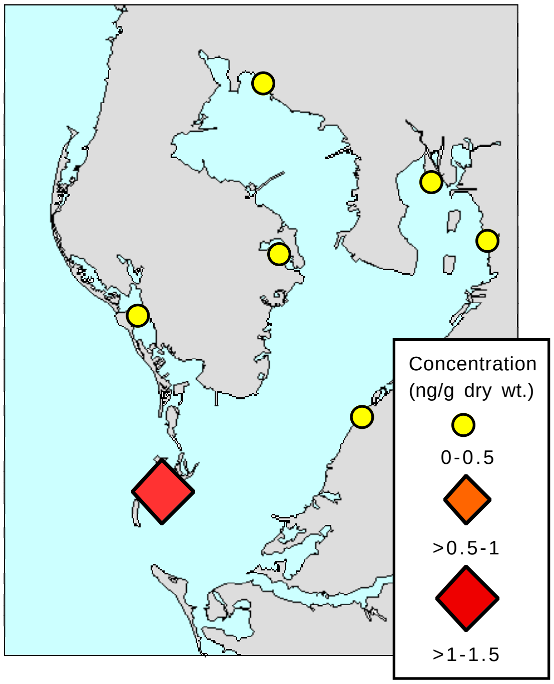

Figure I.18. Hexachlorobenzene in sediment (ng/g dry wt.).

Mirex in sediment

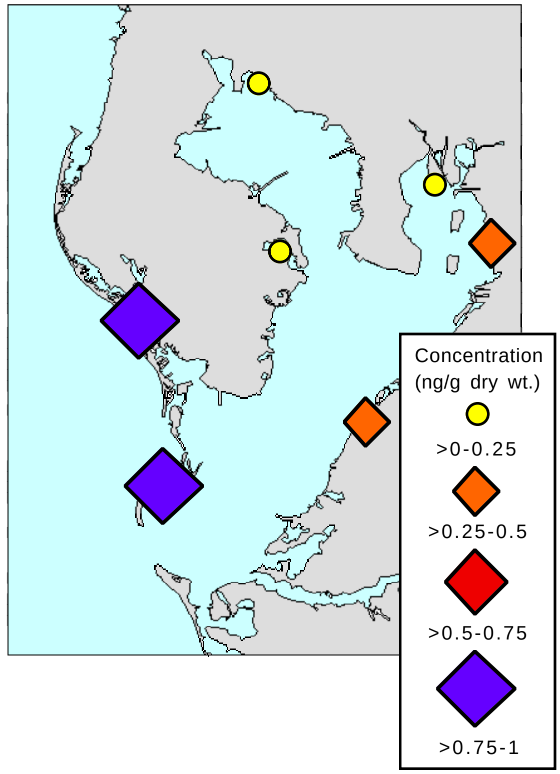

Figure I.19. Mirex in sediment. (ng/g dry wt.).

Mussel Watch sampling site at Mullet Key (TAMU/GERG)

Appendix II

Trace element and organic trends in oysters

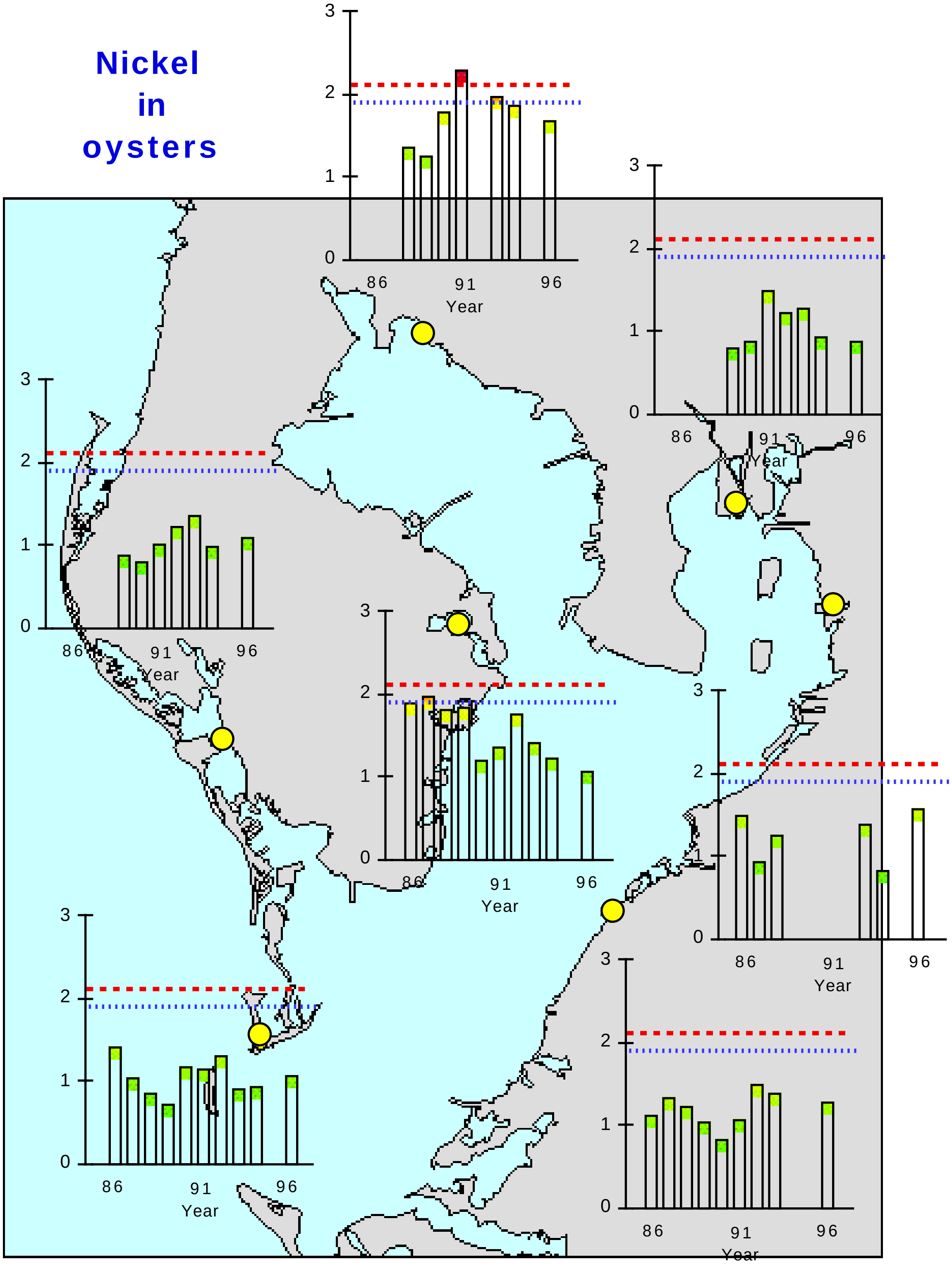

Figure II.1. Nickel in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

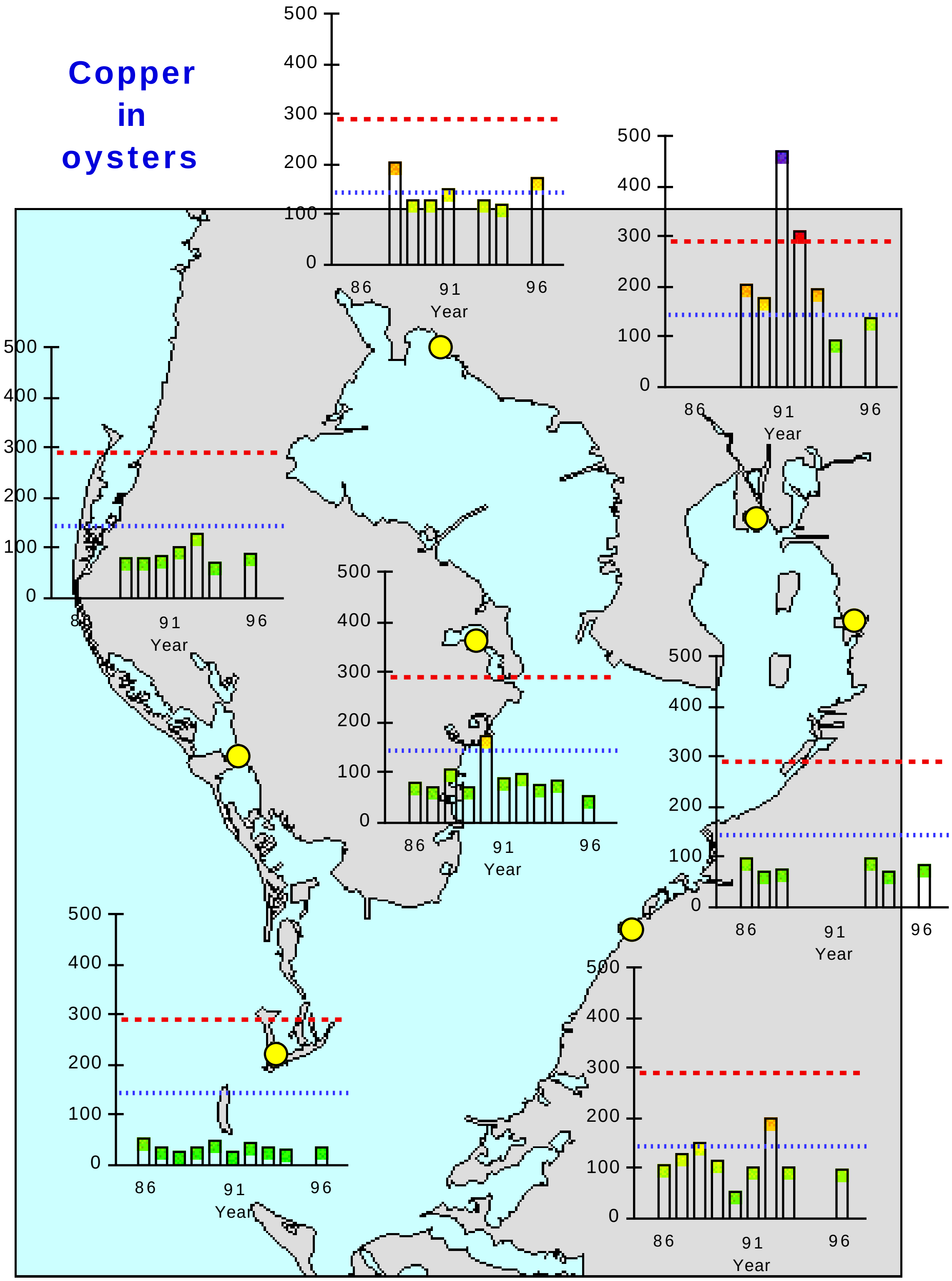

Figure II.2. Copper in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

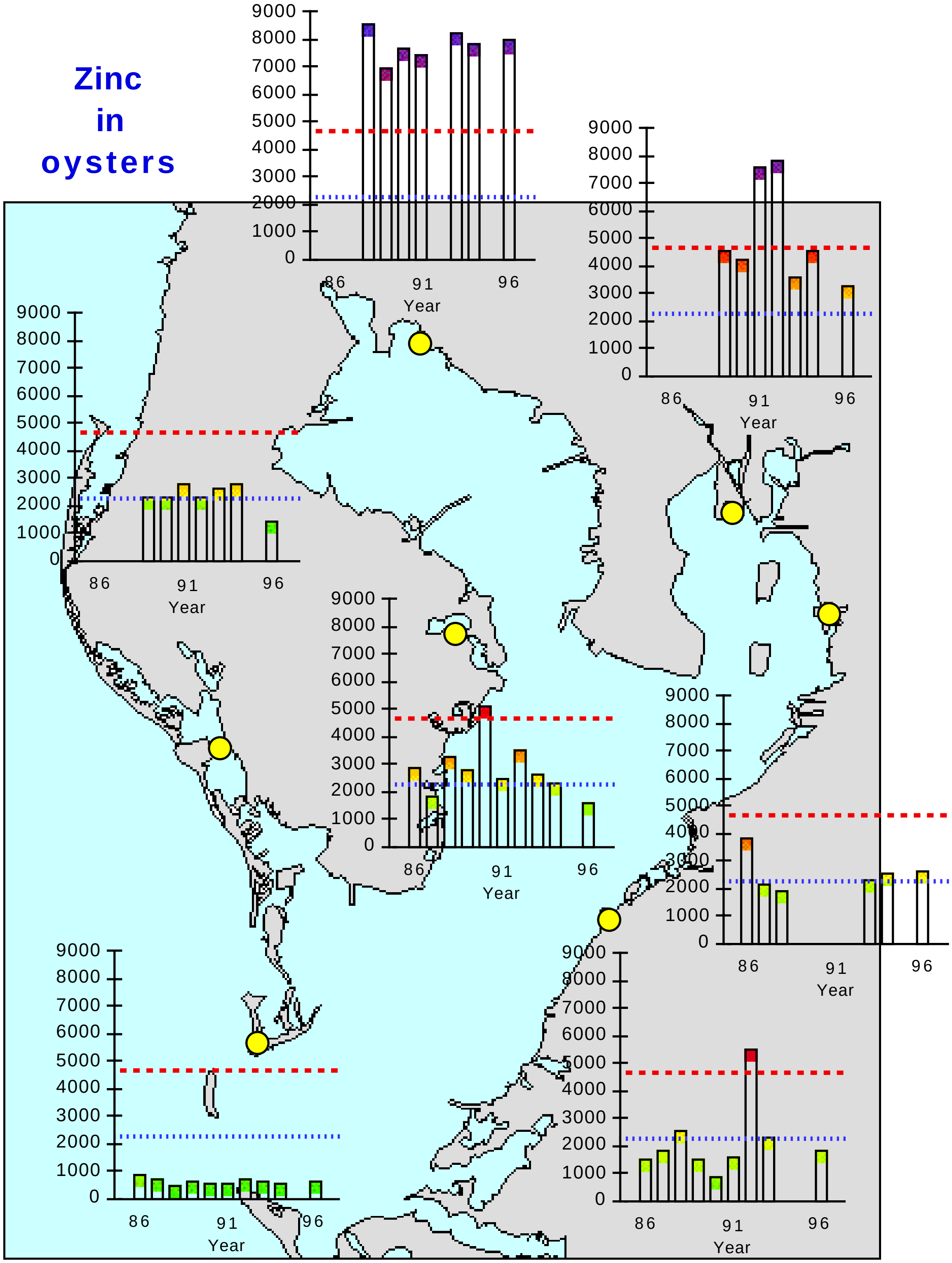

Figure II.3. Zinc in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

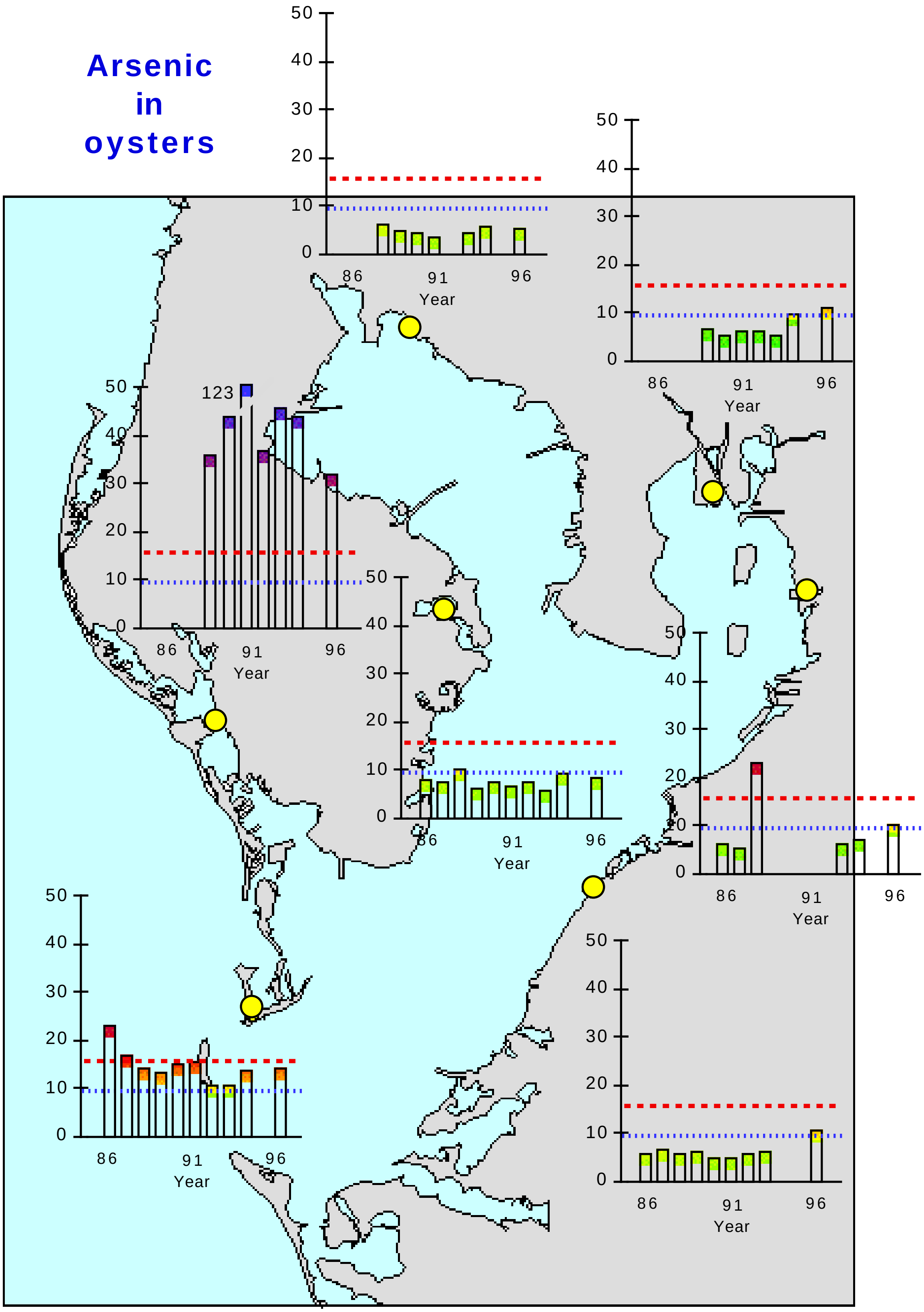

Figure II.4. Arsenic in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

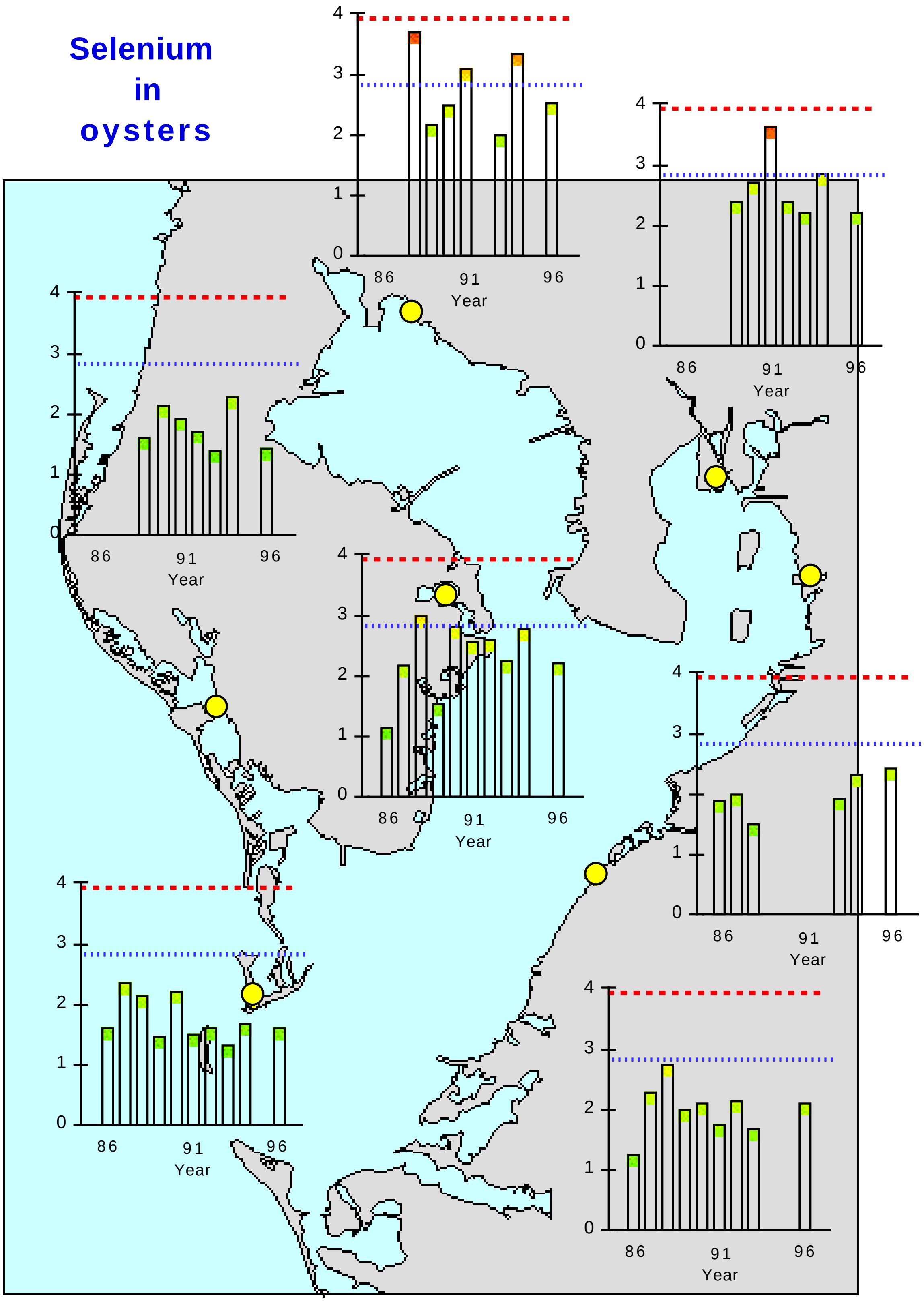

Figure II.5. Selenium in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

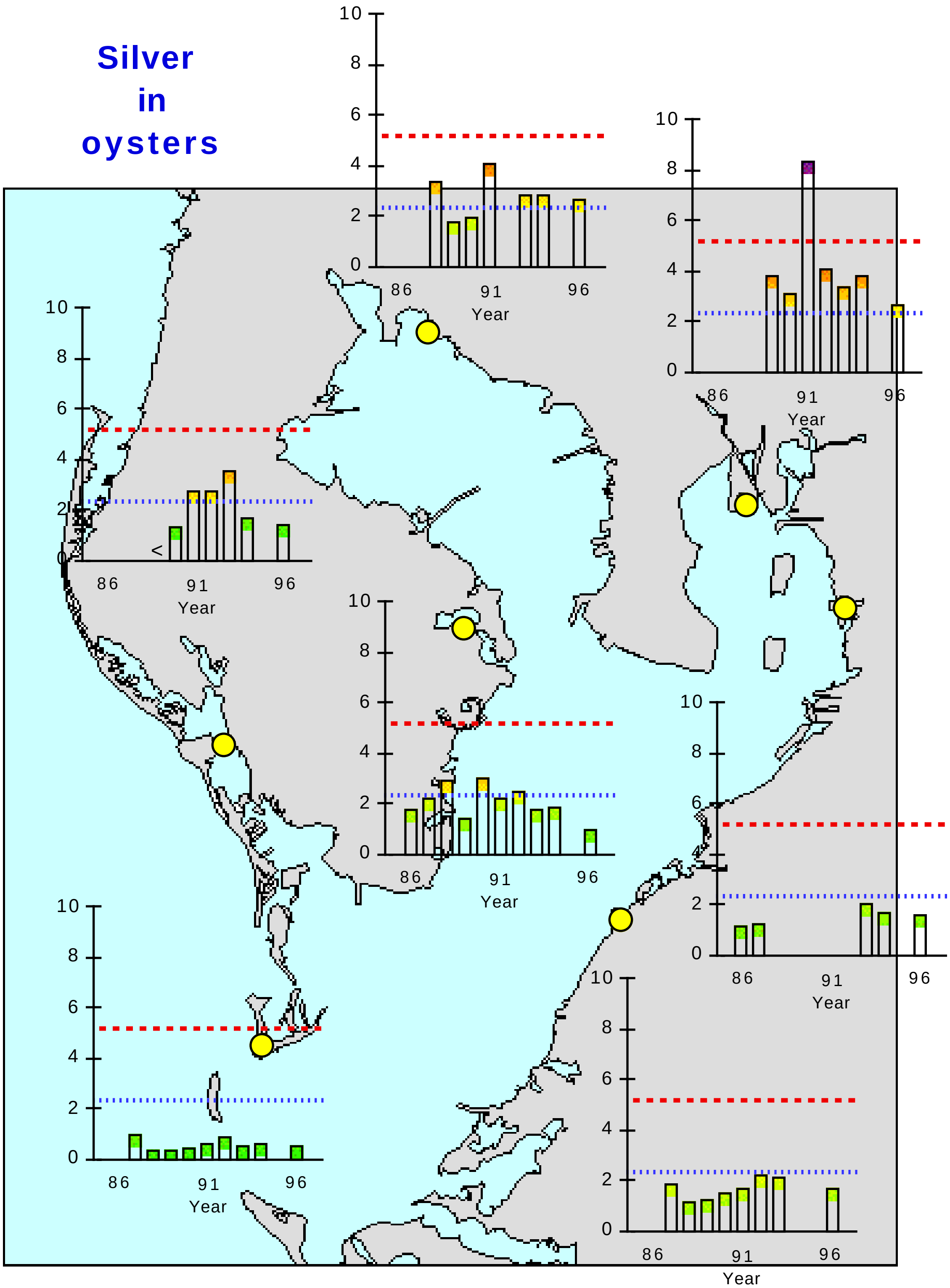

Figure II.6. Silver in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

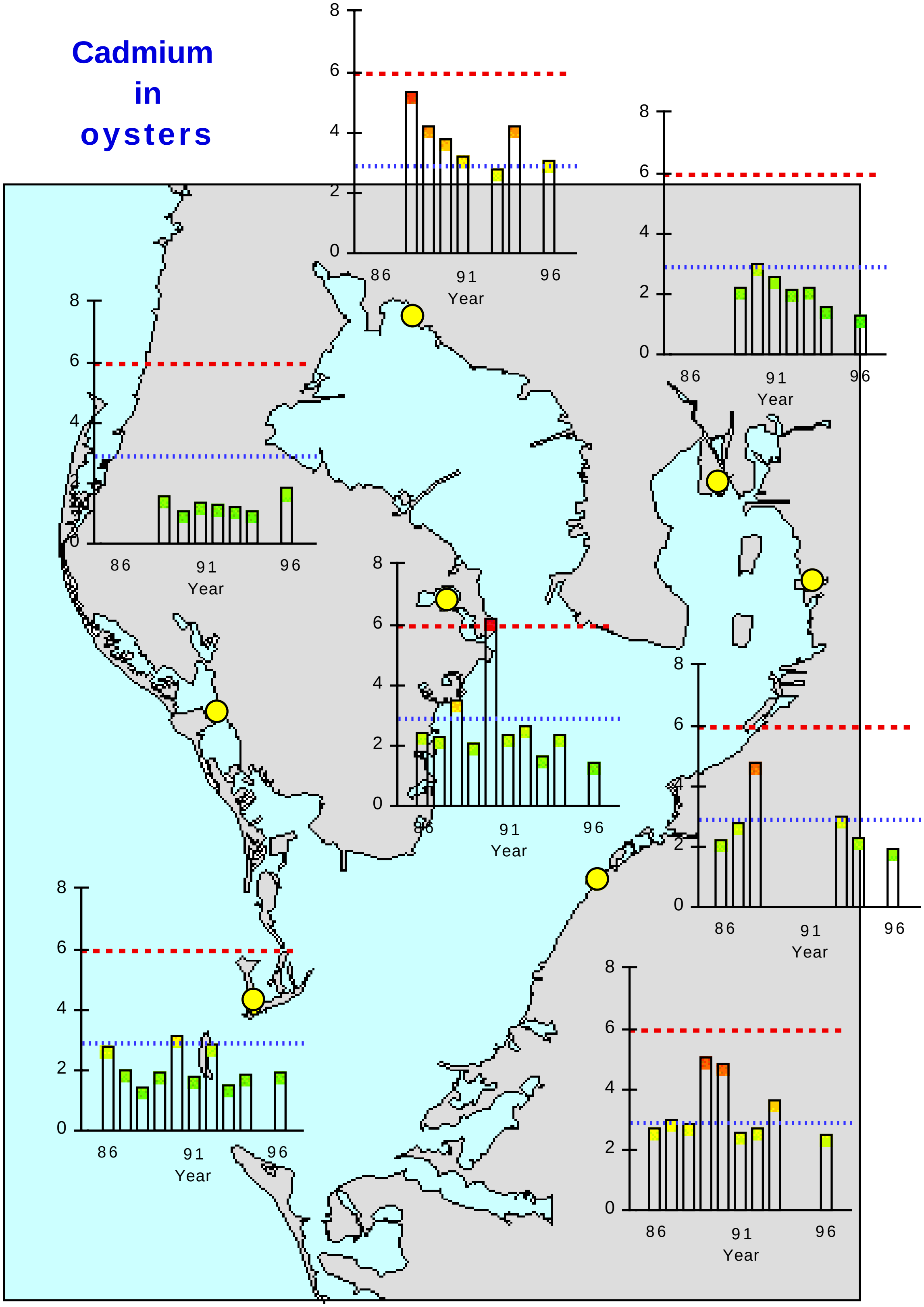

Figure II.7. Cadmium in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

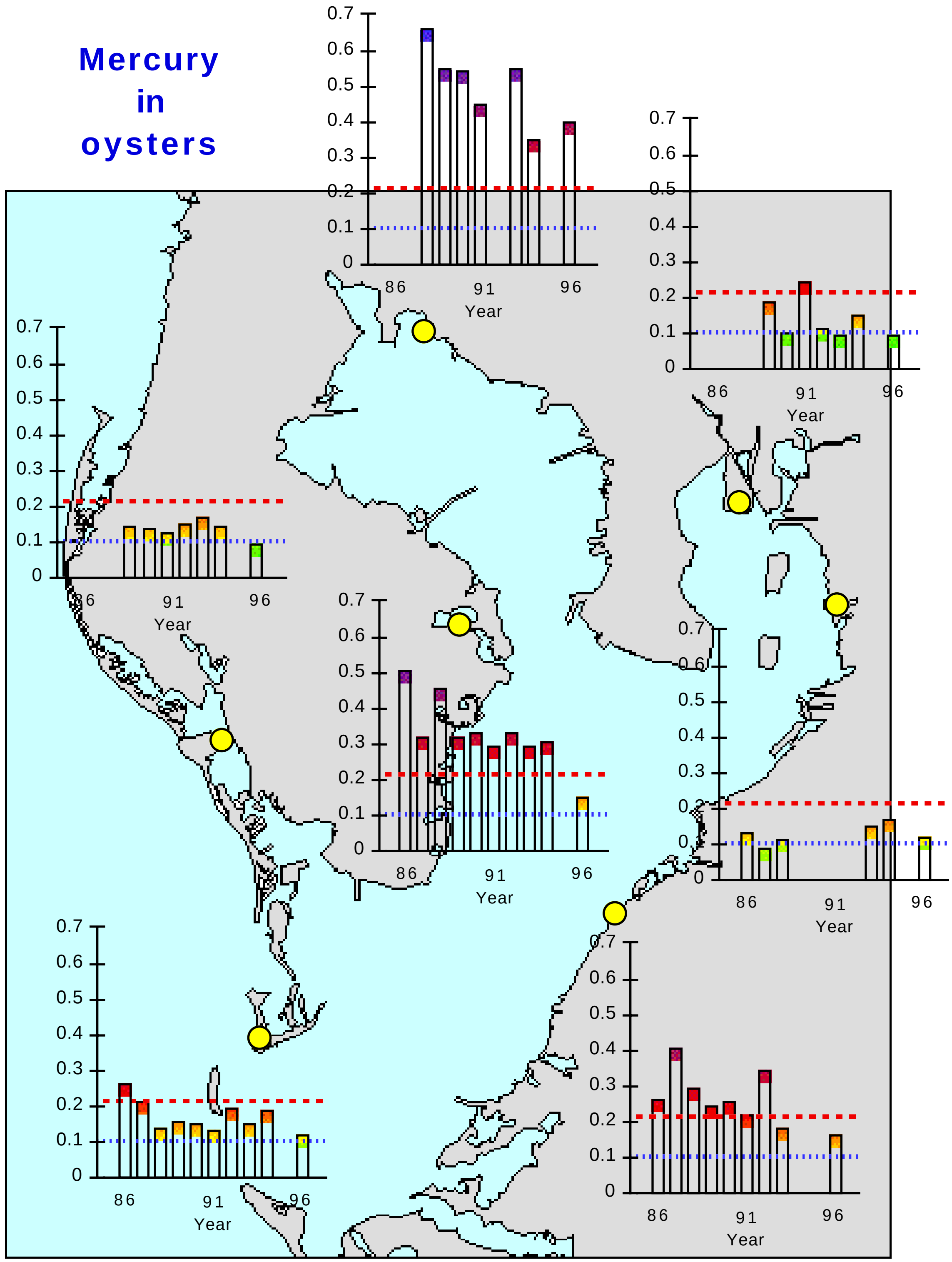

Figure II.8. Mercury in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

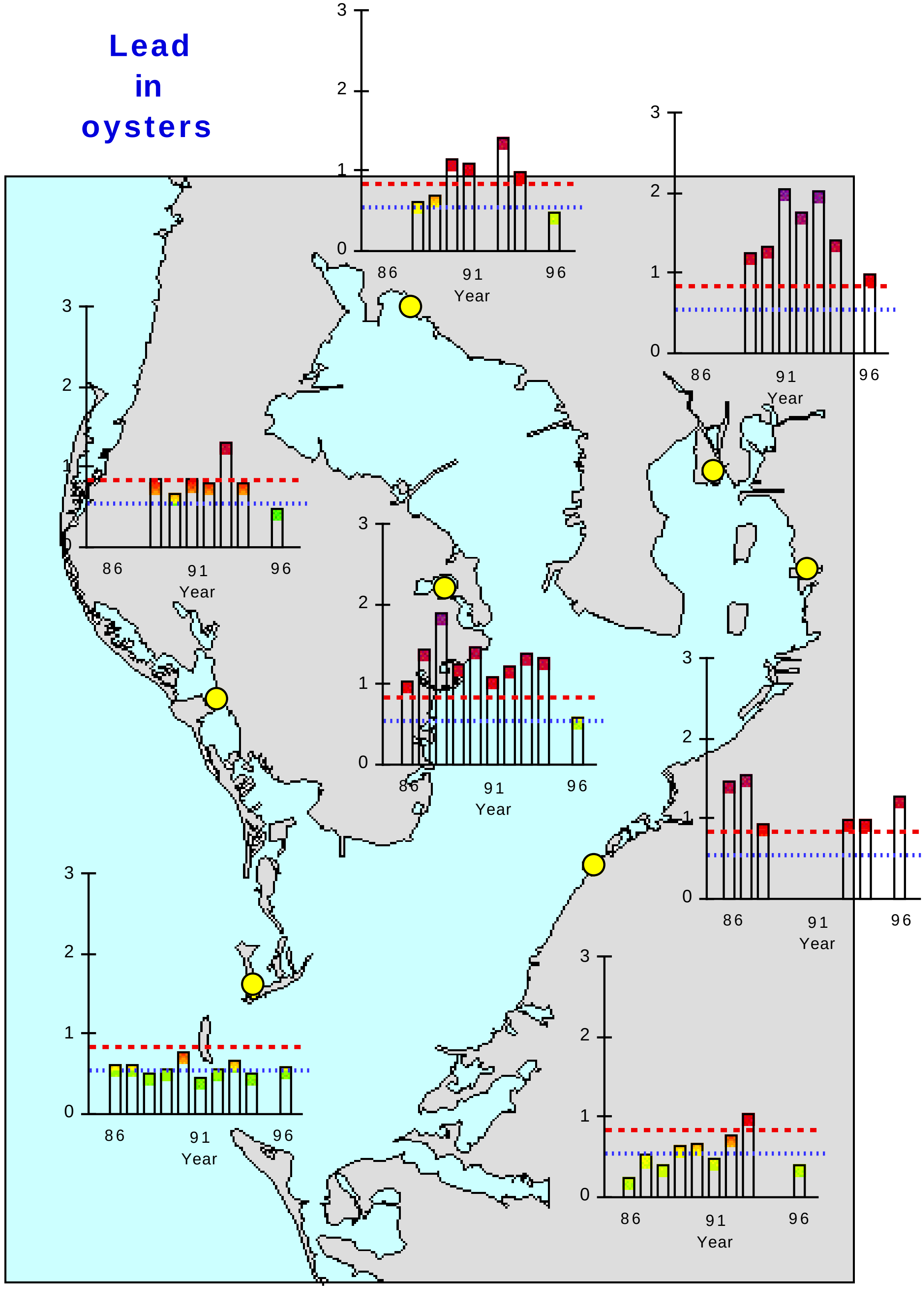

Figure II.9. Lead trends in oysters. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (µg/g dry wt.).

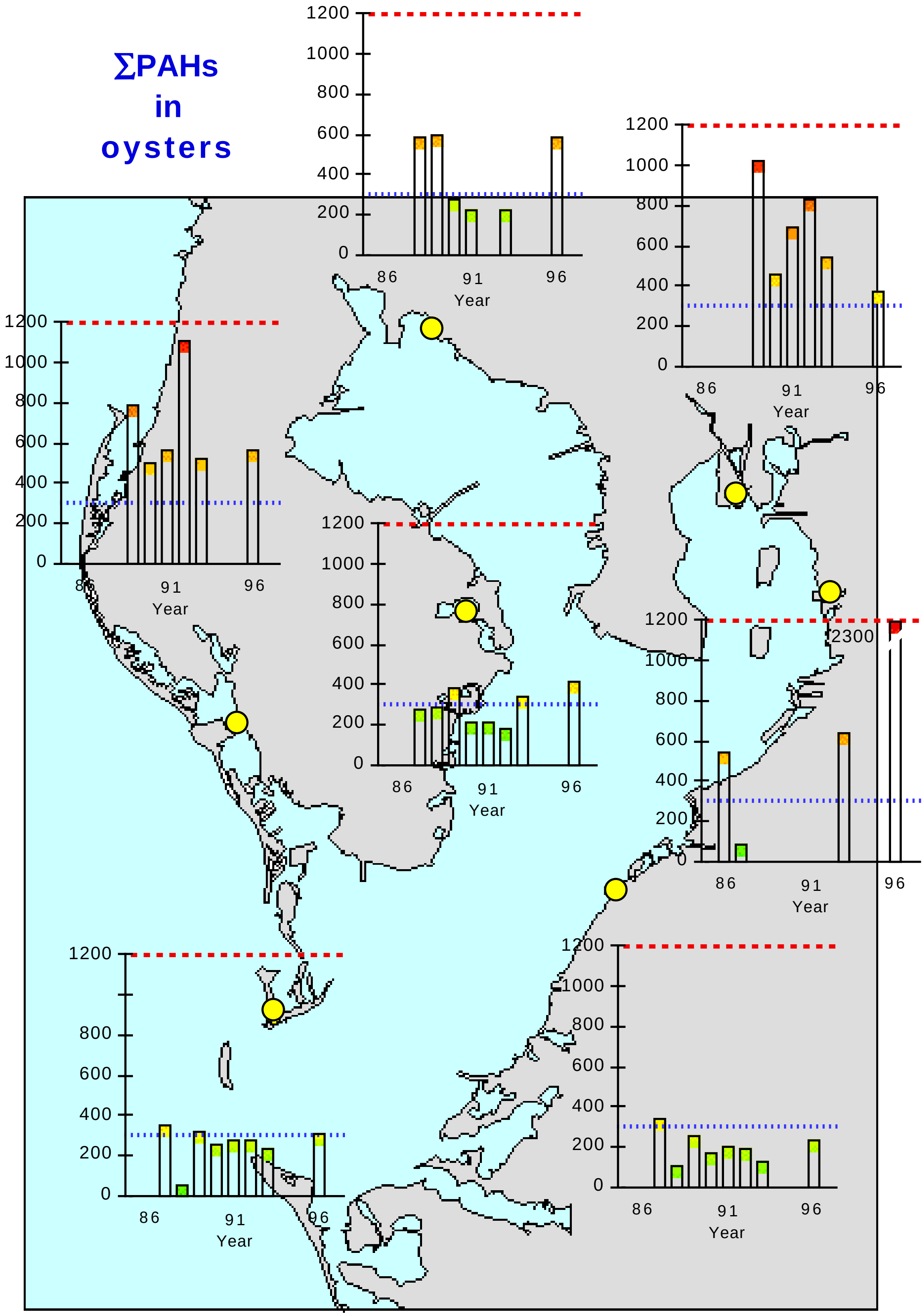

Figure II.9. Total polycyclic aromatic hydrocarbons (ΣPAHs) in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).


Oyster sampling at Navarez Park (TAMU/GERG)


Sediment sampling

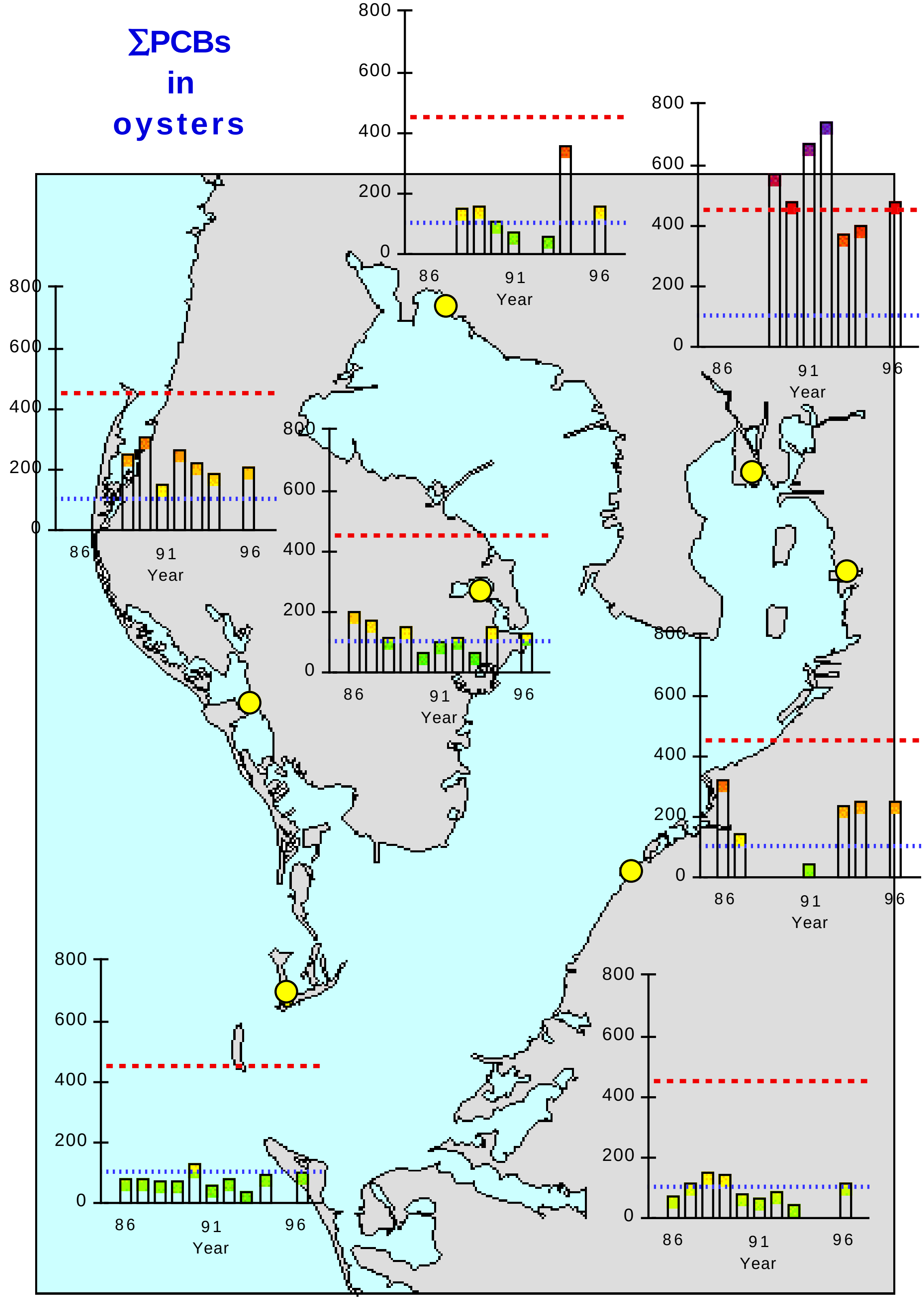

Figure II.10. Total polychlorinated biphenyls (ΣPCBs) in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

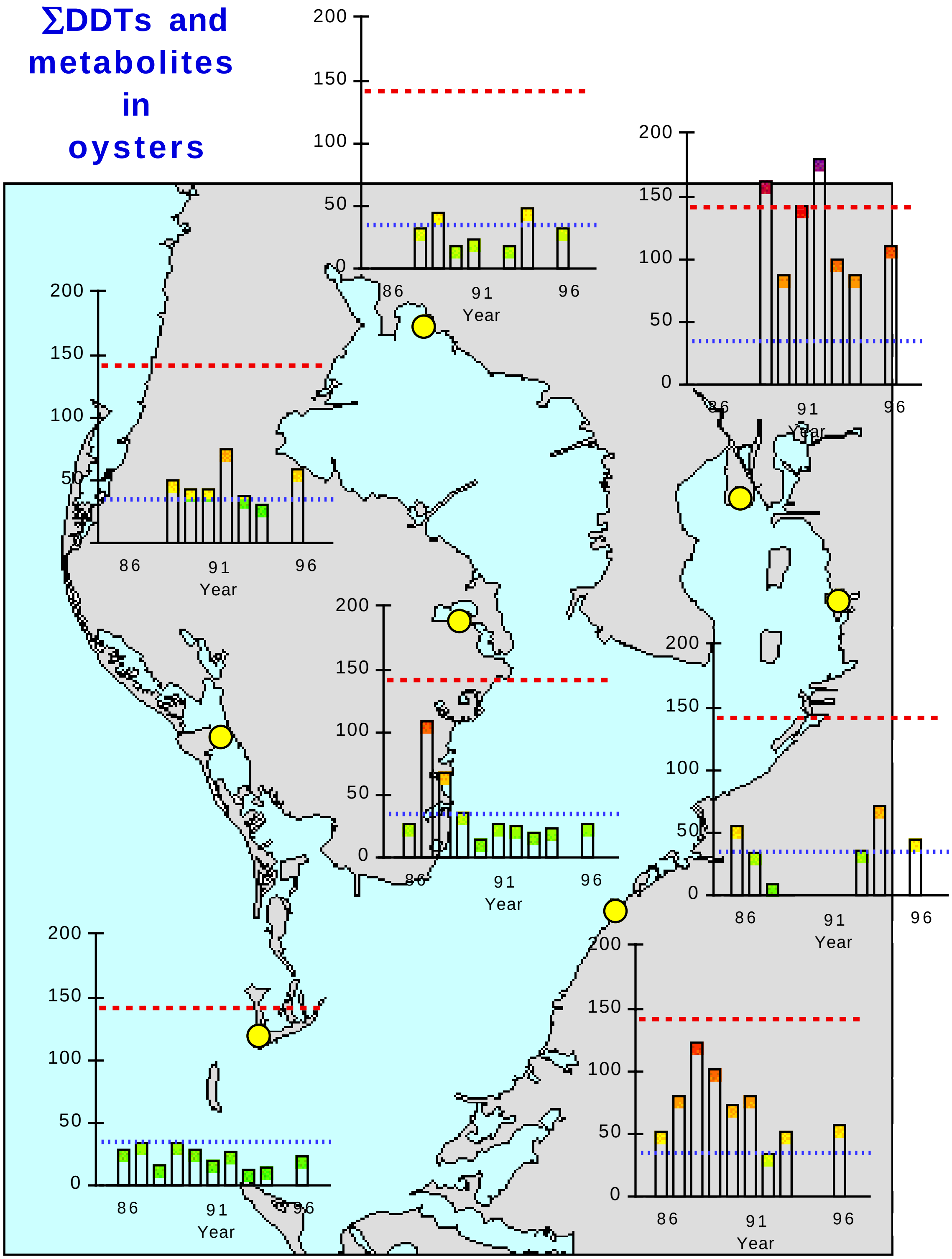

Figure II.11. ΣDDTs and metabolites in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

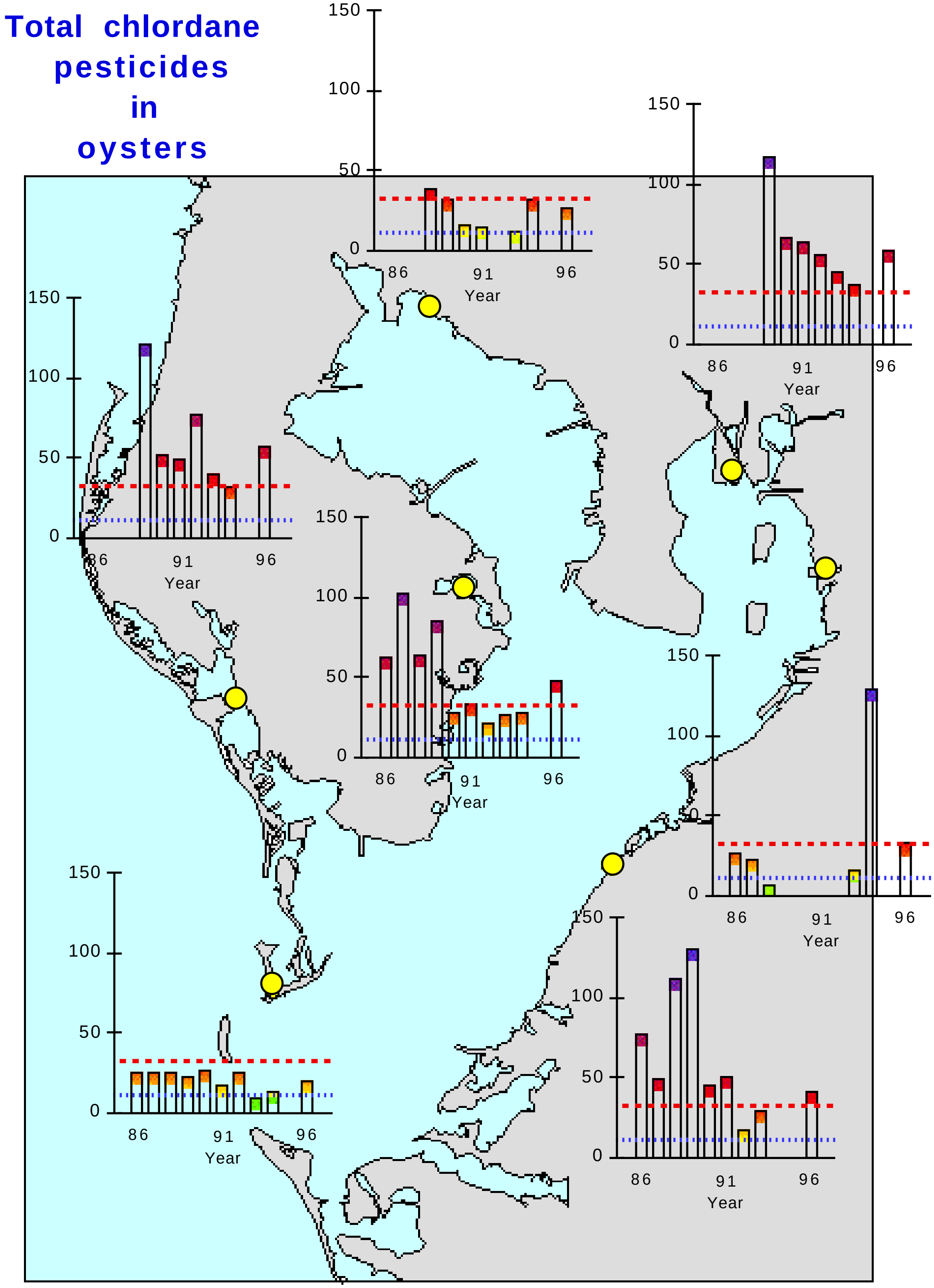

Figure II.12. Total alpha-chlordane, *trans*-nonachlor, heptachlor and heptachlor epoxide in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

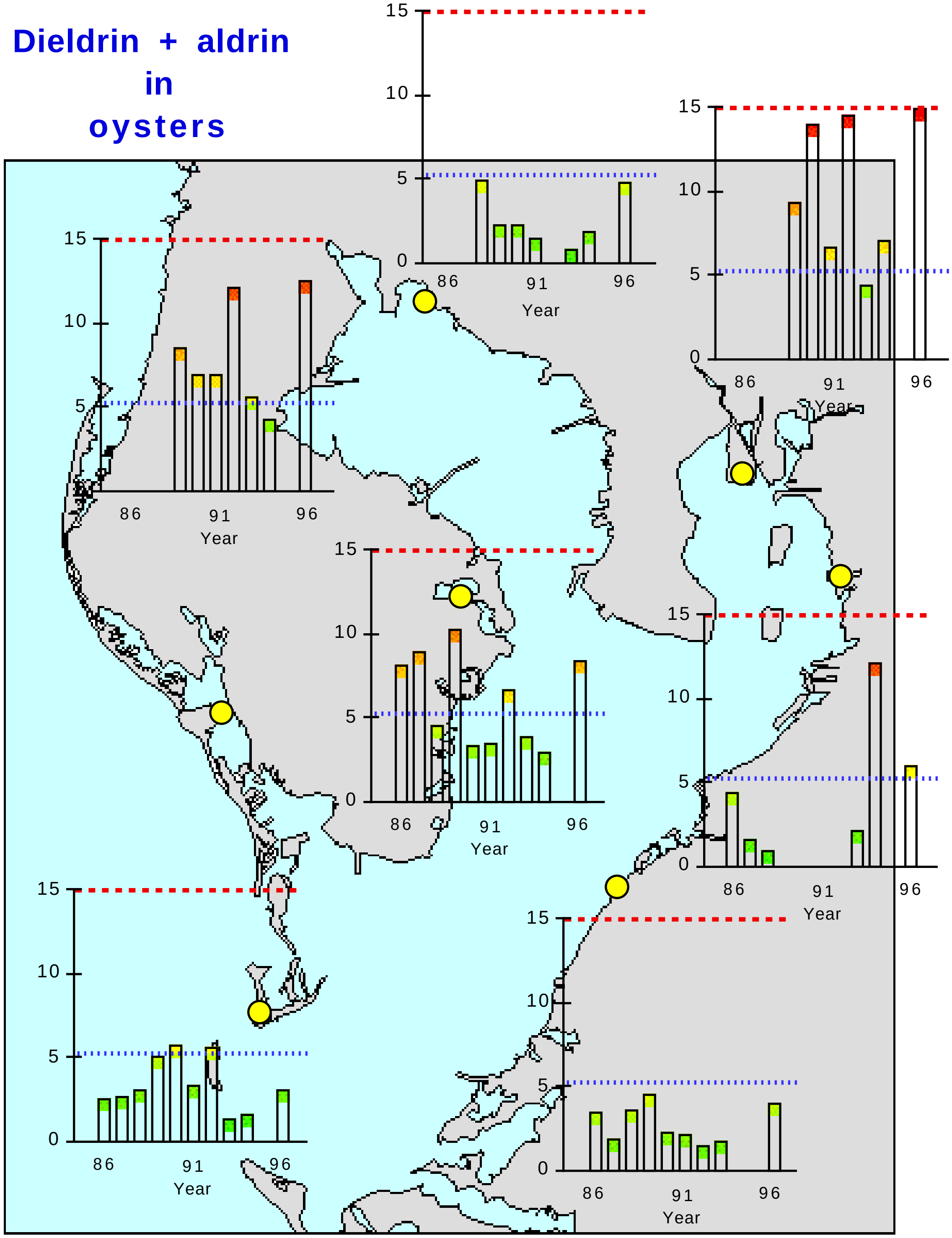

Figure II.13. Total dieldrin and aldrin in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

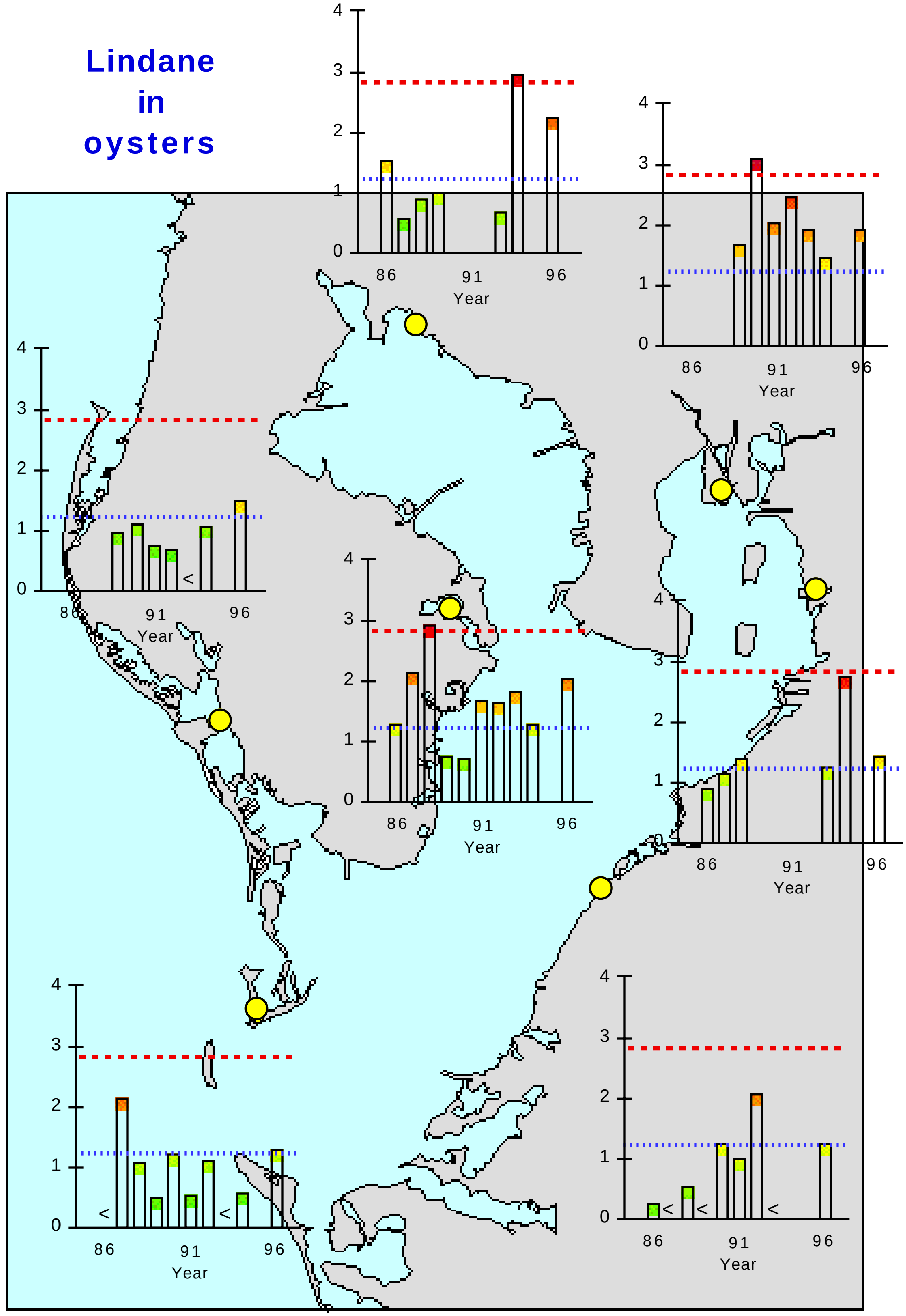

Figure II.14. Lindane in oyster tissue A "<" used to indicate values below the limit of detection. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

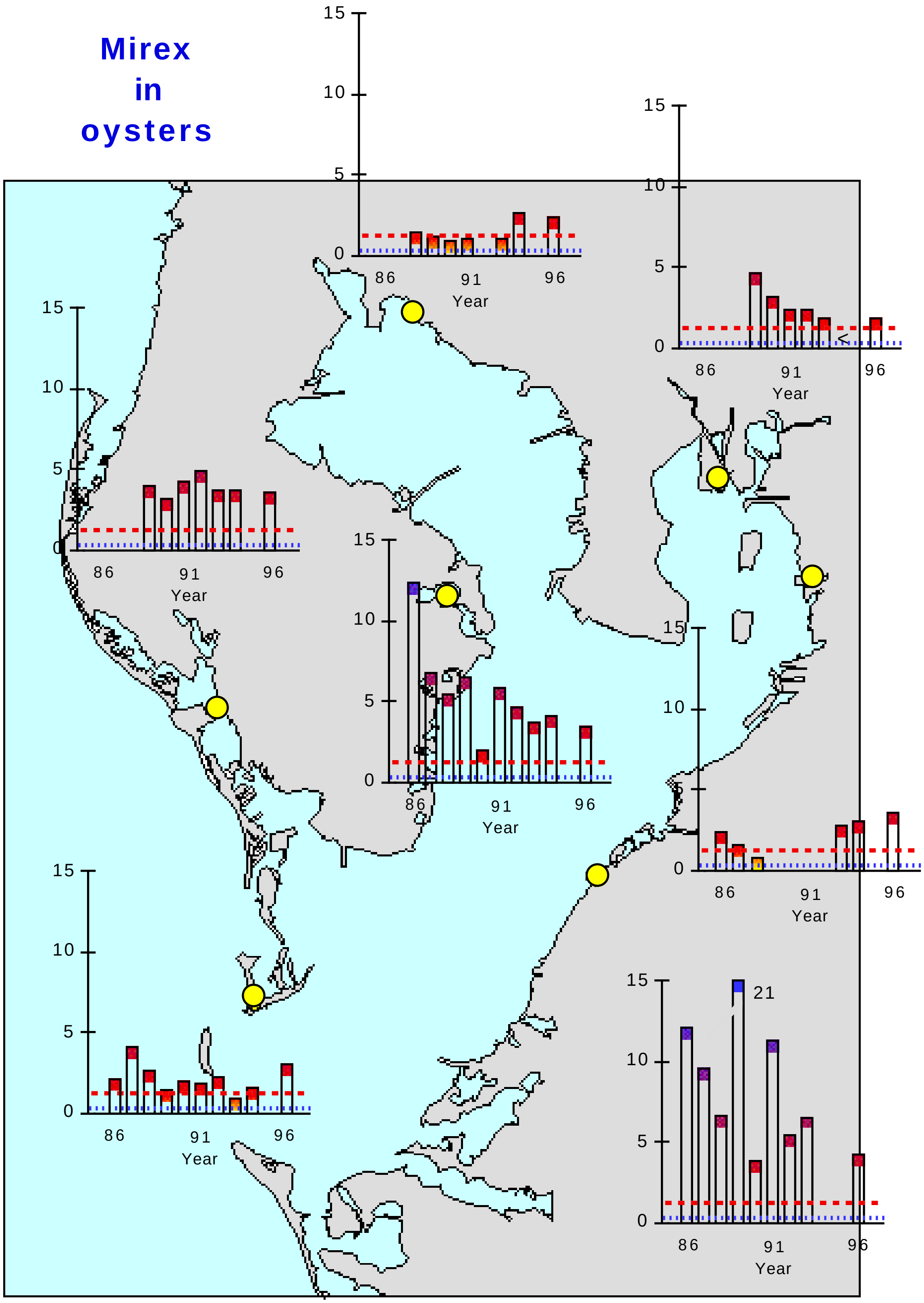

Figure II.15. Mirex in oyster tissue. Dotted blue line is NS&T median and dashed red line is NS&T nationwide 85th percentile (ng/g dry wt.).

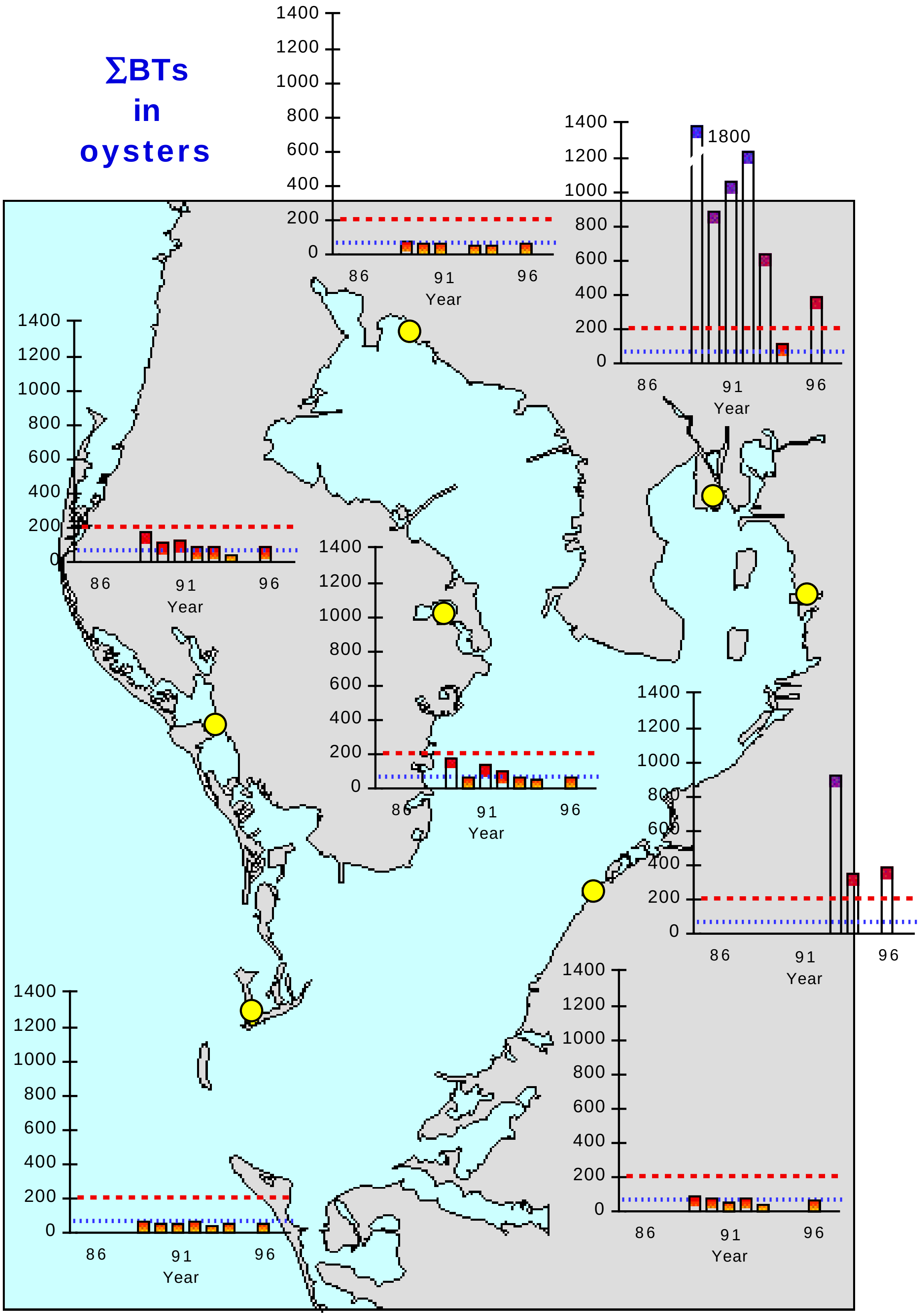

Figure II.16. Total butyltins (ΣBTs) in oyster tissue (ng Sn/g dry wt.).

Mussel Watch sampling site near the Peter O. Knight Airport (TAMU/GERG)

Mussel Watch sampling site in Old Tampa Bay (TAMU/GERG)

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